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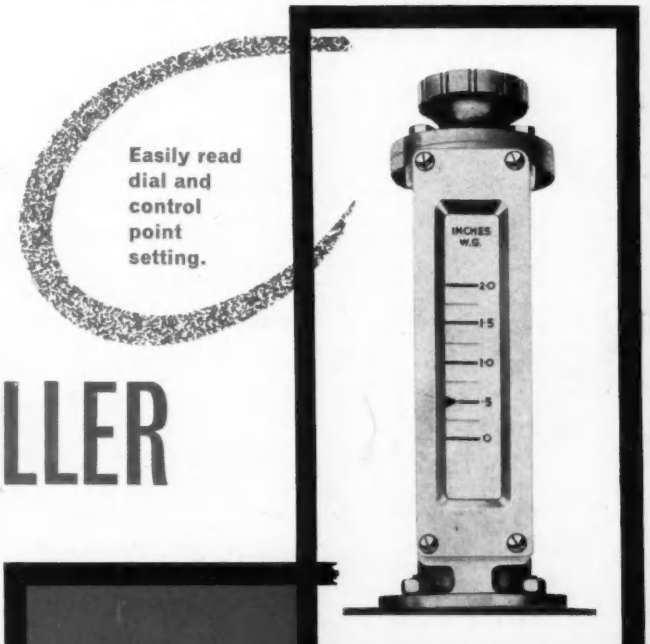

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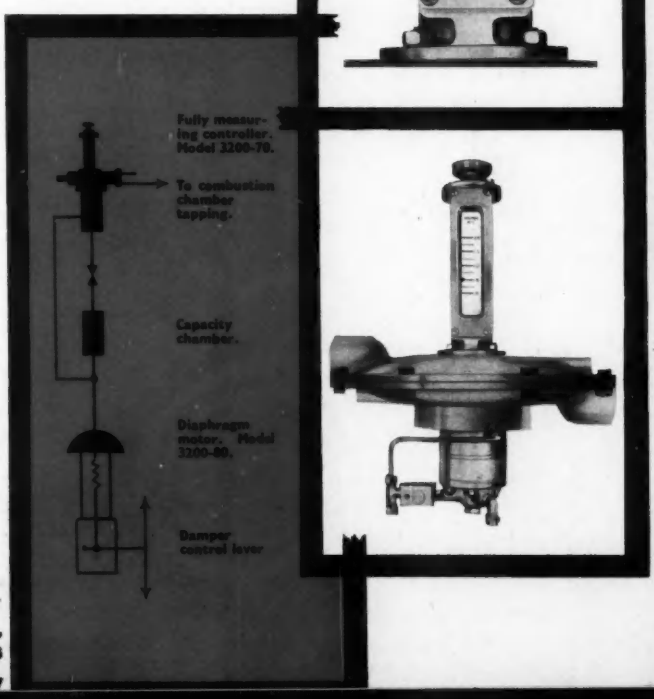

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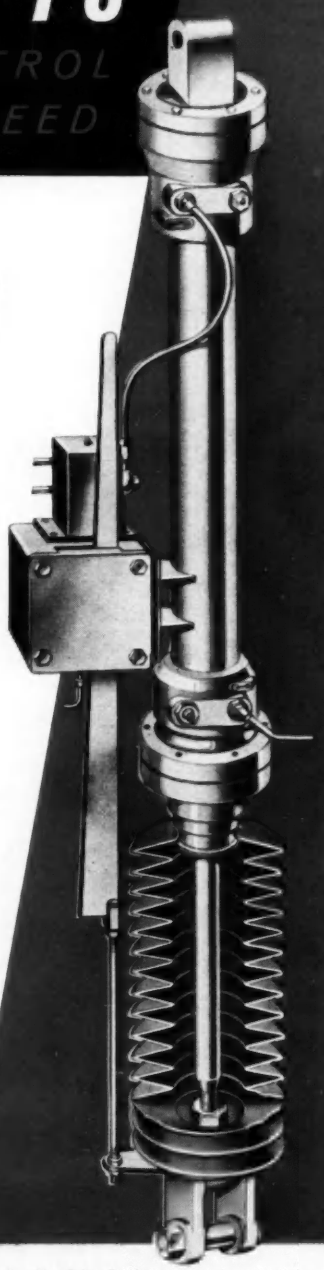

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

APRIL 1961

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

Published monthly by

ENGINEERING REVIEW PUBLISHING CO. LTD.
19-20, NOEL STREET, LONDON, W.1

Annual Subscription Rate, 40s., including postage.

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VOLUME 76 No. 4

B.E.A.M.A.—FIFTY YEARS' ACTIVITY

THE British Electrical and Allied Manufacturers' Association was founded in 1911, and thus now enters its Golden Jubilee Year. The necessity for such an organisation as B.E.A.M.A. to co-ordinate and promote the advancement and prestige of the electrical and allied industries of the United Kingdom is, at the present time, probably more pronounced than ever. By virtue of its status as an incorporated body, the B.E.A.M.A. is precluded by its articles of association from acting in any way that would make it a trade union. The primary aims have been:—the creation of a central organisation to deal with any question affecting the electrical and allied industries; a channel for promoting overseas trade; and an economic and technical intelligence service. In short, the organisation is based on voluntary co-operation between autonomous firms, a policy which experience has proved most economical and effective, notably in that it needs only a minimum of administrative staff, whilst fostering eagerness and enterprise in achieving mutual objectives. Within such an organisation individuals with inventiveness and enterprise are always free to open up new industrial activities, and thereby continually add to the assets of the industry.

The fresh approach being made by the B.E.A.M.A. to the affairs in general of the industry is already beginning to show useful results. In their golden jubilee report, the Council look back upon a year of " further expansion against a background of change and in the face of various obstacles, some of which have yet to be completely overcome. For electrical manufacturers (the report states) 1960 was marked by intensification of the changes which have been strongly influencing the development of the industry in recent years. Technical achievements and the increased pace of technological advance are rapidly affecting the structure of many sectors, such as power generation; changes in Government policy—notably on nuclear power, railway modernisation and consumer goods, have sharply impinged on production programmes; and changing commercial conditions, brought about in some measure by the monopolies legislation, have been accompanied by groupings and amalgamations which have had an effect on the structure of the industry as a whole. Each of these factors is important in itself, and together they present far-reaching implications for the industry. Their impact has emphasised the important functions of the B.E.A.M.A. in keeping the industry together, providing the organisation for the exchange of information and statistics, co-ordinating views and formulating a common policy for discussions with the Government and other organisations at home and overseas. As regards production, the report points out that preliminary figures indicate that the volume of the industry's output rose by 7 per cent. in 1960 and the value was more than £1,600 million. Employment in November, 1960, was, at 795,000, over 30,000 higher than a year earlier. Nearly all the main sectors of the industry maintained or increased their output; in particular, production of turbo-generating plant reached a new record of 5,146-MW, of which 1,891-MW (or 36 per cent.) was exported.

It is estimated that more than £64 million a year is spent in the electrical and allied industries on research and development, and expenditure of this magnitude can only be supported by large-scale and profitable production programmes. In the course of the last few years, more than £15 million has been spent on specialised facilities for electric traction alone; and it has been estimated that research and development account for about 30 per cent. of all nuclear energy costs. It is all the more unfortunate, the report states, that in both these fields, manufacturers, after expanding their capacity to meet the requirements of the original schemes, have been faced with uncertainty and a reduced construction programme.

Exports of the electrical and allied manufacturing industries at £293 million exceeded the record level achieved in the previous year (£285 million), and represented 10 per cent. of the total of exports of manufactured goods from the United Kingdom. In terms of the " balance of trade " however, this increase was more than offset by a rise of £14 million in electrical imports. The total value of these imports represented, for the first time for many years, 20 per cent. of Britain's electrical exports. Evidence of the industry's vitality was the fact that it had expanded faster than any other U.K. industry. Since 1956, the volume of production has risen by more than one-third, while the number of workers had increased by only 13 per cent.

Points and Pointers

REGIONAL TECHNICAL COLLEGES

The list of regional technical colleges in England and Wales is to be revised and a new list formulated

In a circular to local education authorities on March 15th, Sir David Eccles, Minister of Education, explains that up to April, 1959, regional colleges were, in effect, identified with those colleges receiving a special grant for courses in advanced technology. This test is no longer applicable, says the Minister, and it is necessary to review the list of regional colleges and to decide how far it continues to be appropriate in view of recent and prospective developments at the individual colleges and in the regions generally. There are four types of technical college—colleges of advanced technology, regional colleges, area colleges and local colleges. The nine colleges of advanced technology are being developed as centres for work exclusively at university level, including post-graduate work and research. Between these colleges at the apex of the educational system, and the 300 local colleges, there are nearly 200 colleges doing a greater or less amount of advanced work. About 20 of them are at present known as regional colleges, the rest being area colleges. Regional colleges have been envisaged for some years as the establishments to which—after the colleges of advanced technology—industry would look for the development of new advanced full-time and sandwich courses in applied science and technology. The circular says, if advanced work is to be efficiently organised and, particularly if scarce staff and equipment are to be used to the best advantage, regional, and in some cases, national, planning is essential. It is contemplated that in some regions there will continue as at present, to be a need for more than one regional college. But there may be cases in which it will be necessary to choose between colleges, taking account of geographical and other factors. Geographical considerations alone will not entitle a college to regional college status, says the circular. No college will be designated unless the Minister is satisfied that it is capable of discharging its functions adequately, including the provision of a sufficient volume of advanced work, with adequate staff and governing arrangements and suitable premises.

ELECTRICAL ENGINEERS EXHIBITION

The tenth Electrical Engineers Exhibition was opened at Earls Court, London, on Tuesday, March 21st, by the Minister of State, Board of Trade, the Rt. Hon. Frederick Erroll, P.C., M.P. In his speech at the opening ceremony, the Minister said that he was especially pleased to learn that, in 1960, exports of electrical machinery reached a new record figure of £234 million. This is, indeed, a splendid achievement, but the nation needs even more exports. We need not let ourselves become mesmerised by the "league tables" which some people are always compiling, but there is no blinking the fact that the rate of growth in exports of electrical goods from several of the other manufacturing countries is a good bit faster than ours. Exhibitions like the present one play a vital part in our drive for more exports. Last year there were visitors from 76 countries, and this year the organisers sent out overseas a million invitations, accompanied by all those pamphlets, leaflets and catalogues which are conveniently called "trade literature"! This in itself is a magnificent publicity effort on the industry's behalf. Continuing, the Minister said he hoped our friends from overseas, who they were pleased to have with them that day, will forgive him if he had taken the opportunity to address a few frank words to United Kingdom industry. We are honoured by the presence of many distinguished representatives of overseas countries; and their presence gives some measure of the world-wide interest in this exhibition. There was, on exhibition, what must be the largest display of electrical engineering equipment in the world. There were more than £3 million worth of goods on show, and arranged on 473 stands. We think that this is the finest display in the world, as well as the largest. In the theme of this exhibition, "Communications," we see one of the forces which is bringing the peoples of the world closer together. We are very much a part of Europe today, as our membership of the European Free Trade Association shows. By the end of this year, we in Britain will be consuming electricity generated in France, and which will be reaching us by the cross-channel cable.

BERKELEY NUCLEAR LABORATORIES OF THE C.E.G.B.

The Berkeley nuclear laboratories of the Central Electricity Generating Board are nearing completion, and are due to be officially opened on May 29th. Their inauguration will be followed by a four-day international conference on the properties of reactor materials and the effects of radiation damage. More than 100 delegates from 15 countries (including Australia, Belgium, Canada, France, Germany, Israel, Italy, Japan and the U.S.A.) have already accepted invitations to attend the conference. The laboratories—a branch of the C.E.G.B. Research and Development Department—are sited adjacent to the Board's nuclear power station under construction at Berkeley, but, administratively, will be independent of it. Berkeley was an obvious choice for the laboratory site, as it is in an area where it is possible to attract high-grade scientific and technical staff. The locality contains a number of other nuclear power stations and a supply of skilled labour is to hand. The proximity of two important cities (Bristol and Gloucester), and of university towns, was another important consideration. The scientific staff of the laboratories will work in close co-operation with the technicians responsible for the operation and maintenance of all the Board's nuclear power stations, but in addition to operational research, the laboratory programme will have a necessary proportion of fundamental research work. There will not, however, be any duplication of the work being carried

out by the U.K.A.E.A. The laboratories' staff have been recruited over the past two years and will total 170 when work starts there; the number will rise to about 350 shortly. The laboratories have three main divisions—engineering, physics and reactor materials. The engineering hall has a headroom of 60 ft. to permit the erection of the largest reactor rigs; fuel element heat transfer work and fuel element testing and development will be carried out here. The main scientific laboratory block occupies about one-third of the total working area. It contains a series of "caves" and "cells" in which operations on highly radioactive irradiated fuel elements can be made by remote control and without hazard. Apart from providing assistance to nuclear power stations during the commissioning of civil reactors, the physics division will investigate prototype reactor cores, and develop improved methods of measurements. The graphite moderator will be monitored through the life of each of the civil stations in the interests of safety. The Berkeley nuclear laboratories are the focus of the Board's research and development programme in nuclear power, bearing in mind that, at present, experience of nuclear power stations in service in Britain is limited to Calder Hall and Chapel Cross. With the operating experience that will be gained by the Board—potentially the largest owners of nuclear plant in Britain—and the results of the laboratory programme, the Board hopes to be in a very strong position to determine what advanced nuclear systems are likely to be of application to the electricity supply industry in the future.

STANDARDS ENGINEERS' CONFERENCE, 1961

The seventh annual conference of engineers and others concerned with the application of standards is being held this year on May 9th and 10th, and will be opened by the Rt. Hon. Viscount Hailsham, Lord President of the Council and Minister for Science. These conferences have attracted increasing interest over the past years, and have provided a valuable opportunity for discussion and exchange of experience among standards personnel from a growing range of industries. They have also led to the creation of the new "Register of Standards Associates" under the aegis of the B.S.I., and the programme committee of the Register has been active in the planning of this forthcoming seventh conference. It has been decided this year to hold a two-day meeting, with parallel sessions on the second day, to give greater opportunity for detailed discussion. The first day of the conference will consist of plenary sessions at the Connaught Rooms, London, when Sir Stanley Harley (Coventry Gauge and Tool Co. Ltd.) will occupy the chair. After the formal opening by Lord Hailsham, a contribution on the trades union viewpoint on industrial standards will be given by Mr. G. Doughty of the Association of Engineering and Shipbuilding Draughtsmen. Papers will also be given on "An Integrated Standards Programme in the Company" (Mr. F.E. Butcher of Joseph Lucas Limited), "Standards in Product Development (Electronics)" (Mr. D. F. Egan, of Mullard Limited) and "Standards in Market Research and Sales" (speaker to be announced). The second day's programme, to be held at British Standards House, will consist of three parallel sessions in the morning and three in the afternoon to discuss various topics.

TECHNOLOGY AND SCIENCE OUTSIDE UNIVERSITIES

Speaking at the opening of a new students' hostel at the Battersea College of Advanced Technology early in March, Sir David Eccles, Minister of Education, outlined the advance made in the field of technology and science outside the universities. There were today, he said, some 100,000 students in all the British universities taken together. They had secured their "A" level G.C.E.s and were studying for a degree. But how many people knew, he continued, that outside the universities there were almost another 100,000 students studying courses beyond the "A" level of the G.C.E.? Sir David explained that 30,000 were studying in the evenings, 40,000 were studying part-time day courses, and 24,000 were studying in full-time and sandwich courses. Out of this second 100,000, Sir David added, were produced three times the number of engineers who came out of universities. If he read the signs aright, Sir David said, every year industry appreciated more keenly that the colleges of advanced technology were the nurseries of the men who would develop the inventions of the scientists, and remove from Britain the commonly heard complaint that our best brains were brilliant in pure theory, and could produce new ideas but could not with equal brilliance turn their thinking to practical account in the world of production and commerce. This was the reason, Sir David said, why industry was lending more staff and equipment to the colleges of advanced technology, and sending to them more students, so that a figure like the total of sandwich students hit a new record every year.

COAL STOCKS AND PRODUCTION

The Rt. Hon. Alfred Robens, chairman of The National Coal Board, said, during a speech at the Golden Jubilee Dinner of the North-east Branch of The Incorporated Sales Managers' Association, in Newcastle, on March 15th, that up to the beginning of March, the N.C.B. have picked up more than 5 million tons of coal from stock this year, and sold it at the full price it was valued at in their books. Added to the 6 million tons which they lifted last year, that has brought the Board's stocks down from 36 million tons at the end of 1960 to less than 24 million tons; this has gone a long way towards bringing the stock position into balance. It is not the intention of the N.C.B. to run down stocks too far; sufficient coal will be kept in stock to allow for flexibility to meet sudden fluctuations in demand in future. Productivity is steadily mounting; up to week ending March 10th, the average output per manshift this year has been 28.6 cwt., surpassing all previous records for the industry, and only the recent influenza epidemic and the strike of Yorkshire miners prevented the figure from being higher still. This is, said the chairman, striking evidence both of the increasing confidence among the miners, and of the determined efforts they and management are making together to fight intensive competition. Further, as an additional sign of the strengthening of the general feeling of optimism in the industry, more men are now coming into the pits, including many trained miners who left the pits at a time when morale was low. But more men are needed in certain coalfields—particularly in Yorkshire and the Midlands, and South Wales.

Power Plant Developments

—— by the ——

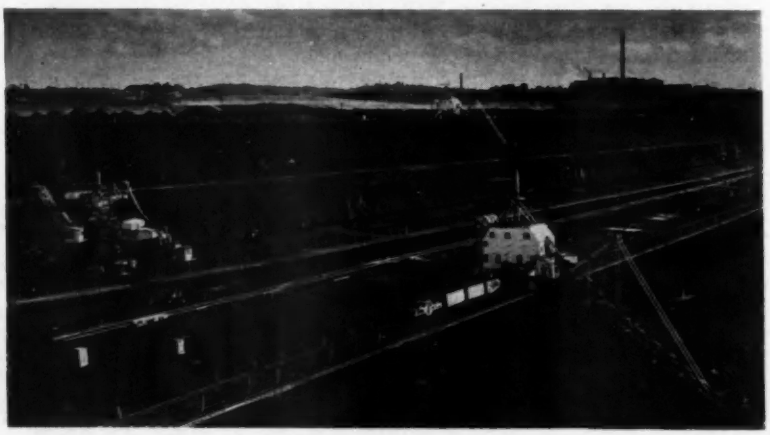
Victoria State Electricity Commission

IT was in 1918 that the then Premier of Victoria, Australia, Mr. (later Sir) Harry Lawson, announced his Government's intention of creating a State Electricity System for Victoria. In the closing days of that year, the Victorian Parliament gave effect to this policy decision, and passed the Act creating Victoria's State Electricity System. The establishment of the State Electricity Commission (known in its earliest years as the Electricity Commissioners) was the great turning point, not only in Victoria's electrical development, but also in the development of the State's enormous wealth of brown coal supplies. From the first tentative efforts of small, independent electricity undertakings and pioneer attempts in the latter part of the 19th century to utilise Victoria's extensive brown coal resources, has grown a closely co-ordinated system of power and fuel development by the State Electricity Commission, today the largest electricity authority in Australia, with capital assets now totalling more than £307 million. Since its earliest days, the Commission has fulfilled the double task of generating and supplying electricity and, at the same time producing brown coal fuel both for immediate use in its own power stations and also for the manufacture of higher-grade fuel in the form of brown-coal briquettes. The two functions are closely interconnected.

About 96 per cent. of the people of Victoria are now supplied by the State electricity system, which is being rapidly extended to embrace all populated regions of the State. With the continued expansion of its coal-winning operations in the Latrobe Valley in the eastern part of the State, the Commission has also become the largest individual fuel producer in Australia, and the annual output of its brown coal open cuts, now totalling over 13 million tons, will be 22 million tons in 1970.

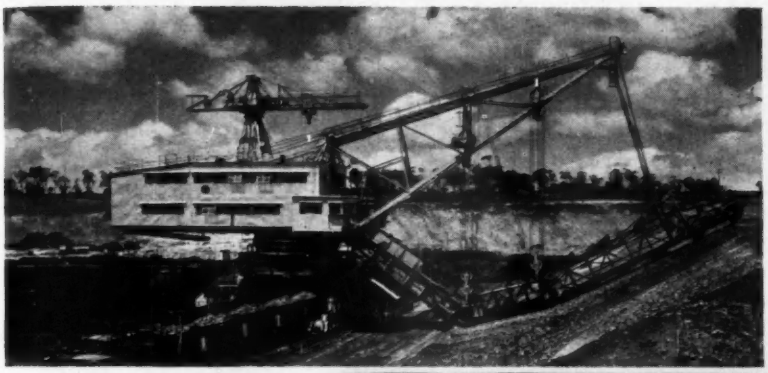
The Commission is vested with power to erect, own and operate electrical undertakings; acquire existing electricity undertakings; supply electricity retail to individual consumers or in bulk to any corporation or public institution; establish brown coal open-cuts; and own and operate briquette works. It is the authority also for developing the State's water power resources for the generation of electricity. The growth of the Commission has been rapid and consistent. From its system, more than 869,000 consumers are today supplied with electricity. Outside the State system there are now only about 20,000 other consumers served by isolated local undertakings. The State generating system produces almost all Victoria's electricity, and serves three-quarters of the populated area of Victoria. It supplies the whole of the metropolitan area of Melbourne, and over 1,500 other centres of population. Of the 869,000 consumers served by the system, about 680,000 are supplied directly by the Commission, and the remainder by municipal authorities which buy their electricity in bulk. Over 45,000 farms are supplied by the State system, and a further 1,900 farms by local country undertakings.

Almost the whole of the Commission's area of supply is served by one interconnected system. This comprises steam, hydro and internal combustion power stations located at convenient centres in many parts of the State and feeding electricity into a common power "pool" for distribution through a State-wide supply network. Power stations in the interconnected State generating system comprise the large base-load steam station at Yallourn; the base-load steam station at Morwell; three steam stations in Melbourne; two more steam stations at Geelong and another two at Ballarat; eight hydro-stations located at Kiewa in the Australian Alps, at Eildon Dam on the Goulburn River, and on the

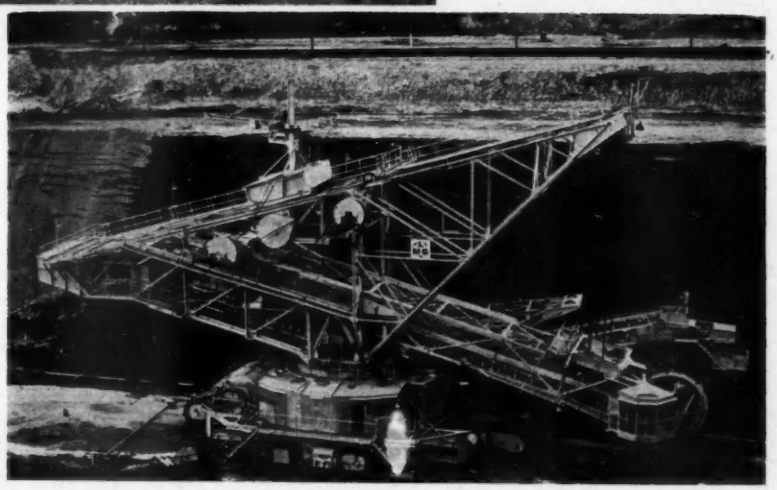


General view of the brown-coal open-cut at Yallourn where both bucket-wheel and bucket-chain types of dredger are used for coal winning.

Rubicon and Royston Rivers near Eildon; and internal combustion power stations at Shepparton and Warrnambool respectively. In addition, the Victorian interconnected State generating system is linked by a 330-kV transmission line with the Snowy Mountains hydro-electric scheme in south-eastern New South Wales. This not only enables Victoria to share in the output of the Snowy Mountains scheme, but also permits of large-scale interchange of electricity between the Victorian and New South Wales State generating systems. The total installed capacity of the Victorian State generating system (both interconnected and regional) now totals 1,500-MW, including Victoria's entitlement to power from the above mentioned Snowy Mountains scheme, and its share of the output from Hume Power Station.



(Above). Overburden dredger in operation at the Morwell open-cut, which is about six miles from Yallourn.



(Right). Bucket-wheel coal dredger at the Morwell open-cut. Some of the largest coal-dredgers can each excavate about 1,750 tons/hr. of coal.

Brown coal resources

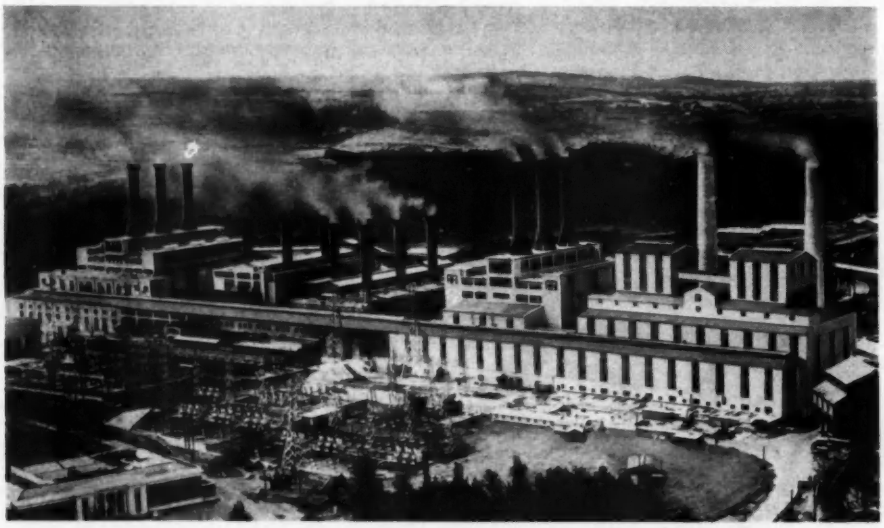
Today, two-thirds of all the electricity produced in Victoria is generated in steam power stations burning brown coal in its natural state as it comes from the open-cuts, or manufactured into brown coal briquettes. Yallourn Power Station and the new Morwell Power Station, operating entirely on raw brown coal, together generate more than half of Victoria's electricity. Once regarded as almost worthless, the brown coal deposits of the Latrobe Valley are now recognised as one of the State's greatest assets. The value of the coal lies in the fact that it is the most economical means available in Australia today of obtaining thermal energy continuously in great quantity. The potentialities of Victoria's brown coal deposits in the Latrobe Valley are enormous. From Yallourn eastwards, the coal belt is practically continuous for 40 miles, and for much of the distance is between five and ten miles wide. Within this belt is one of the greatest continuous deposits of brown coal in the world. The deposits comprise thousands of millions of tons of brown coal in seams ranging in thickness from 200 to 450 ft., and covered by only a shallow sandy soil overburden. Due to the highly favourable ratio of coal to overburden, they are exceptionally well-suited for large-scale open-cut development; and further coal seams are known to exist at less economically favourable levels below the top seams.

Brown coal which could be economically won in large-scale workings by present open-cut methods totals about 17,500 million tons. These deposits provide immense supplies of brown coal to meet all Victoria's needs for electricity generation, industrial and domestic solid fuel, and gas-making. Included in this great coal belt, and forming an important part of the deposits proved suitable for open-cut working, is the immense coal-field covering about 60 square miles on which are located the Commission's undertakings at Yallourn, and at Morwell, which is about six miles from Yallourn.

At Yallourn and Morwell two types of dredger, viz., bucket-wheel and bucket-chain, are used to win coal. The most recently-installed dredgers move on large "crawler" tracks, but three dredgers at Yallourn, all of the bucket-chain type, move along rail tracks as they operate on the coal face. The largest dredger can excavate 1,750 tons/hr. of coal. To enable these coal dredgers to operate, about 5 million cubic yards of overburden are removed annually by large modern dredgers. The spoil is delivered by electric trains to

overburden spreaders, and at Yallourn it is distributed in worked-out sections of the open-cut. Brown coal won at Morwell is fed by the dredgers direct on to a belt conveyor system. At Yallourn, electric trains transport brown coal from the dredgers to the power station and the briquette works. The Commission's combined narrow-gauge railway system at Yallourn and Morwell comprises about 65 miles of track, and handles the largest tonnage of any industrial railway system in Australia. The whole of the combined annual output of the main open-cut at Yallourn and the one at Morwell tons of briquettes. In 10 years' time also, preparations will, it is expected, be well-in-hand for a new power station in the Latrobe Valley, and another brown-coal open-cut. These new developments are creating in the Latrobe Valley the most important power and fuel centre in the Southern Hemisphere.

The installed generating capacity of Yallourn Power Station is being further increased to more than 600-MW. Work is in progress on an extension of 240-MW capacity, which is due to have the first of its two 120-MW generating sets in service this year, and to be completed during



General view of Yallourn power stations. The "C" station is on the extreme left, then the "A" "B," "D" and "E" stations in that order to right.

—nearly 12 million tons—is used at the Yallourn and Morwell power stations, and for briquette making. Incidentally, these briquettes provide a high-quality fuel possessing more than three times the calorific value of the raw brown coal.

Progress at Yallourn since power and fuel production began in 1924 has transformed 14 square miles of scrub country into the industrial nerve centre of the State. The Yallourn enterprise today comprises one of the largest brown-coal open-cuts in the world, the largest power station in Australia, and briquette works which (together with the newly-developed works at the Morwell undertaking) are the only ones of their kind outside Europe. In addition to the main Yallourn open cut, there is also a subsidiary open cut at Yallourn North. The Commission is now engaged upon an extensive programme of brown coal development for power and fuel, involving a large expansion in electricity production at Yallourn, and the establishment of another very large brown-coal-burning power station, viz., Hazelwood Power Station, near Morwell. The new combined power and briquette undertaking at Morwell is now almost complete. In approximately the next 10 years, at Yallourn and in the Morwell area, the State Electricity Commission will have in operation two major open-cuts and one subsidiary open-cut, together producing about 22 million tons of brown coal a year; three major brown-coal-burning power stations with a combined annual production of over 11,000 million units; and two briquette works with a combined annual production of approximately 2 million

1962. The Commission's new development for power and fuel at Morwell consists of a large brown coal open-cut, a large new power station operating like Yallourn, on brown coal, and a modern briquette works.

Morwell Power Station is now the third largest producer of electricity in the Victorian State system, while the modern briquette works have an output of about 1,300,000 tons a year. Morwell open-cut is being developed to supply brown coal fuel for the new Hazelwood Power Station—in addition to its present output. The installed capacity of Morwell Power Station is 110-MW, but this will be increased to 170-MW in 1963. Some of the electricity generated at Morwell is used to operate the briquetting plant, but most of the output of the power station is transmitted to terminal receiving stations in Melbourne for distribution through the State supply network.

The briquette works at Morwell (together with the pioneer briquette works at Yallourn) provide a large proportion of Victoria's industrial fuel requirements, and fuel for the Commission's power stations in the Metropolitan area and provincial cities. The Morwell works also provide the briquettes required for the production at Morwell of town-gas for piping under pressure to Melbourne, in the gas works built and operated by the Gas and Fuel Corporation of Victoria.

The new Hazelwood Power Station will have an ultimate capacity of 1,200-MW. It will have six turbo-alternator sets, each of 200-MW capacity. The first of these generating sets will be commissioned in 1964, the

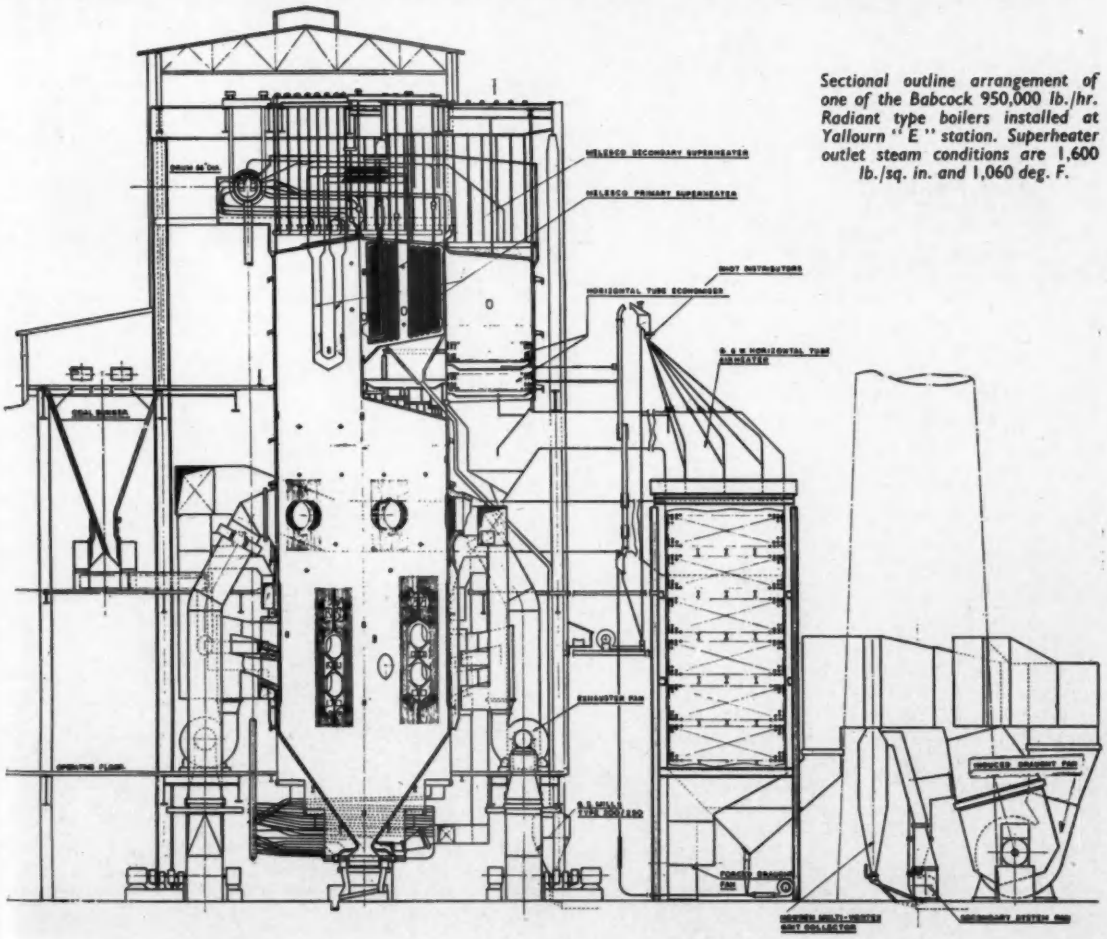
second in 1965, and the succeeding units in 1967, 1968, 1970 and 1971. Contracts have been placed for the first two generating units and their associated boiler plant. Brown coal fuel for the new power station will be delivered from the Morwell open-cut direct by belt conveyor.

Hydro-electric development

Side-by-side with its development of the brown coal fields in the Latrobe Valley, the Commission is also actively developing, as a valuable supplementary source of electricity supply, the water-power resources within Victoria, and in addition, shares with New South Wales the output both of the Snowy Mountains hydro-electric undertaking and Hume Power Station on the River Murray. For more than 30 years it has operated hydro-electric power stations—the oldest established being a group of four on the Rubicon and Royston Rivers in mountain country about 60 miles north-east of Melbourne. A large hydro station (Eildon) utilises irrigation water released from Eildon Reservoir on the Goulburn River, one of the biggest reservoirs in the Southern Hemisphere, and having a storage capacity of $2\frac{3}{4}$ million acre-feet (750,000 million gallons). Eildon Power Station has two 60-MW generators, and two small generators each of 8-MW capacity. Victoria's most important hydro-undertaking is at Kiewa, in the mountainous country in the north-east part of the State. One power station (26-MW) has been in service since 1944; a second (26-MW) was completed in 1956, while a third power station of 96-MW was completed at the end of 1960. Victoria's entitlement from the Snowy scheme will increase by stages, and is scheduled to rise to 200-MW by 1963.

PLANT INSTALLED AT YALLOURN

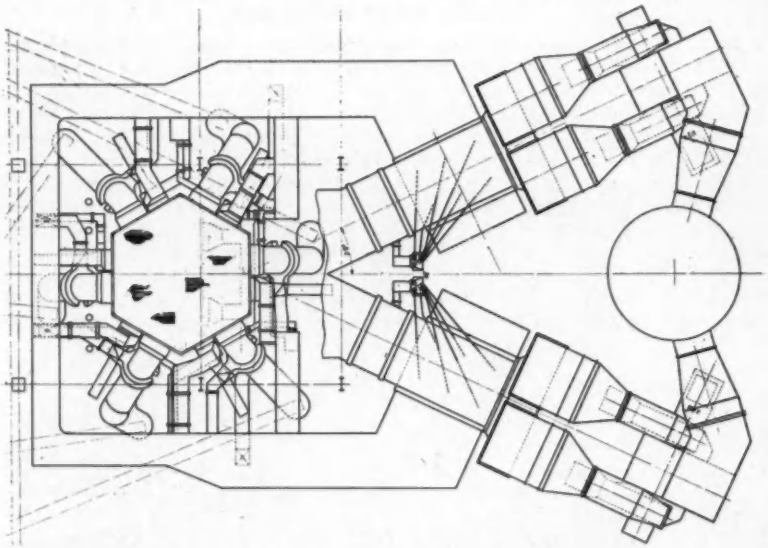
As mentioned earlier in these notes, the first plant at Yallourn was placed in service in 1924, and in what is known as the "A" station. This plant comprised 12 John Thompson water-tube boilers, and six 12.5-MW turbo-alternators which were supplied by Metropolitan-Vickers Electrical Co. Ltd., Manchester. Between 1932 and 1938, station "B" was progressively commissioned, the plant comprising ten John Thompson boilers, and four 25-MW Metropolitan-Vickers generating sets. The period 1954-1957 saw the progressive commissioning of the "C" station with six John Thompson boilers and two 50-MW sets supplied by C. A. Parsons & Co. Ltd., Newcastle upon Tyne. The fourth extension,



Sectional outline arrangement of one of the Babcock 950,000 lb./hr. Radiant type boilers installed at Yallourn "E" station. Superheater outlet steam conditions are 1,600 lb./sq. in. and 1,060 deg. F.

known as the "D" station, was commissioned and completed during the years 1956-1958, with another six John Thompson boilers and two further Parsons 50-MW generating sets. All units in these four stations, or sections, are still in operation.

It is of interest to note that the plant in the Yallourn "A" station (1924) required 8 lb. of brown coal fuel to allow for the generation of 1 kWh of electricity. The "B" station plant required 7.2 lb., the "C" and "D" stations plant 5 lb., while the estimated figure for the "E" station is 3.8 lb.



(Left). Sectional plan through boiler furnace showing arrangement of coal burners of which there are 12 per boiler. The disposition of the I.D. fans and the two air-heaters per boiler is also shown.

(Below). General view during construction of rear of Babcock boiler E2 with boiler E1 in background. The two air-heaters serving the boiler can be seen in the centre foreground.

The new "E" station, due for completion during 1962, allows for an additional site-installed generating capacity of 240-MW comprising two 120-MW machines, being supplied together with the associated auxiliary plant, including transformers and switchgear, by Australian Electrical Industries Pty. Ltd. (associated company of Associated Electrical Industries Limited, London).

The two boilers for steaming the new 120-MW sets, are being supplied by Babcock & Wilcox of Australia Pty. Limited—the design details, drums, pressure-parts, milling equipment, coal-feeders, h.p. steam and feed piping, ash sluice-pumps, etc., being supplied by Babcock & Wilcox Limited, London. These boilers are of the Babcock Radiant type, each unit having a capacity of 950,000 lb./hr. at m.c.r. Steam pressure at the superheater outlet is 1,600 lb./sq. in., and the temperature 1,060 deg. F., when operating with a feedwater temperature of 420 deg. F. The guaranteed performance of these boilers is based upon conditions where the moisture content of the brown-coal fuel is within the limits from 64 to 67 per cent.

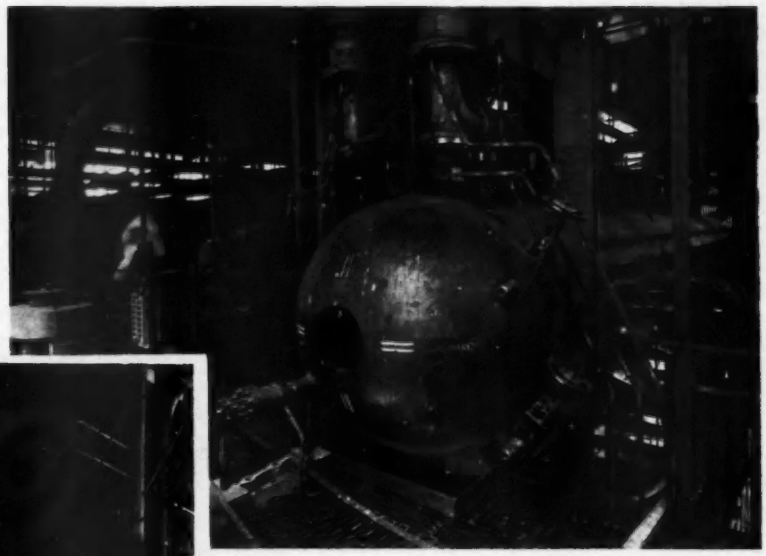
The drum for each boiler has an internal dia. of 5 ft. 6 in., a length of 50 ft. 5 in., and weighs approximately 80 tons. The constructional arrangement of the boiler allows for the centre-line of the drum to be set at a height of 148 ft. 6 in. above basement-level. The furnace is of water-cooled tangent-tube construction and is of hexagonal cross-section.

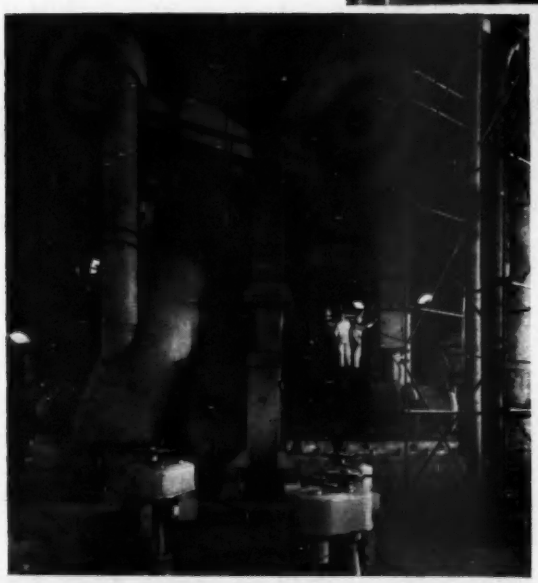
The combustion equipment for each boiler comprises six beater-type pulverising mills, each with an independently-driven exhauster, and each fed by one scraper-feeder system from the main raw brown-coal bunkers. Two auxiliary mills, also of the beater-type, are provided for crushing brown-coal briquettes which will be used for lighting-up purposes. Each pulversing mill is designed for a maximum rating of 43 tons/hr. There are six mills per boiler, each mill being arranged to feed two burners, of which there are 12 per boiler, arranged two in each of the six walls of the hexagonal furnace, these burners being of the open-port type.

They are arranged for tangential firing, this being considered the most suitable in view of the fact that very wet brown-coal was to be used, and that large amounts of hot gas have to be recovered from the furnace (just above the burners) to be used for fuel-drying purposes.

The drive units for the exhauster fans for the coal pulverising mills comprise squirrel-cage motors each rated at 310 h.p. at 740 r.p.m. and

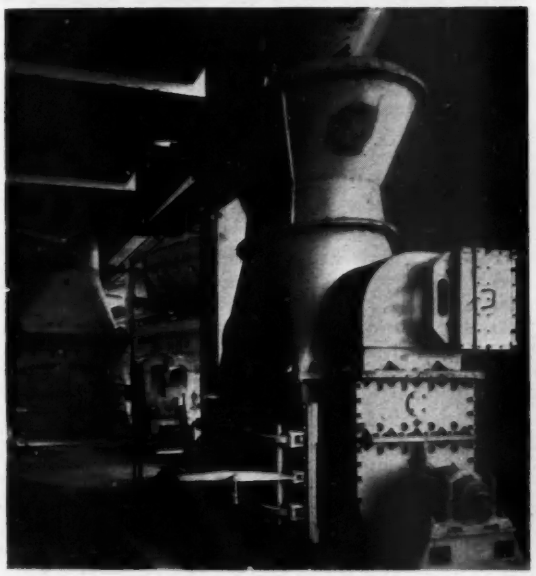
(Right). View at drum gallery level of Babcock boiler E2 at Yallourn "E." The centre line of the drum is 148 ft. 6 in. above the boiler house basement-level.



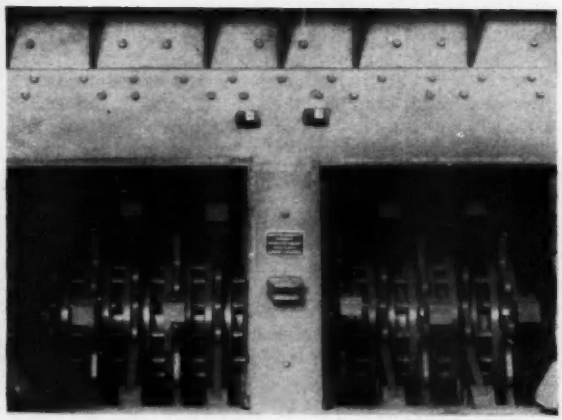


(Left). View during final stages of construction at operating floor level of Babcock E2 boiler. An exhauster fan, with its driving motor and fluid coupling can also be seen.

(Below, left). On left is one of the six beater type mills supplied for each boiler, and on right one of the auxiliary mills, also of the beater type, of which there are two per boiler, and which are used for crushing brown-coal briquettes for lighting-up purposes.



(Below). Interior of one of the beater type main pulverising mills, showing hammer arrangement. Each mill has a maximum Capacity of 43 tons/hr.



Vulcan-Sinclair size-36 scoop-control fluid couplings of the S.R.C.4 type, supplied by Fluidrive Engineering Co. Ltd., Isleworth, and giving variable speed regulation from 720-150 r.p.m.

Incidentally, Fluidrive Engineering Co. Ltd. also supplied numerous fluid couplings through which squirrel-cage motors drive the coal-handling conveyors. These couplings, of both traction and scoop-control types, are of sizes ranging from 17.75 F.C.U. to 26 S.C.R.F., for various motors, horse-power ranging from 75 to 241.

Other Babcock equipment for each boiler includes a continuous-loop type economiser, a horizontal-tubular type air-heater, shot-cleaning equipment, and electrically-operated sootblowers. The continuous-loop type economiser is arranged in two banks, the upper-bank comprising four, and the lower bank five, complete double loops—the tubes extending across the full width of the boiler. The heating surfaces of the upper and lower banks are 21,200 and 22,200 sq. ft. respectively, this giving a total economiser heating surface of 43,400 sq. ft. The horizontal tubular-type air-heaters (two per boiler) have a combined heating surface of 380,000 sq. ft., air temperatures being inlet 104 deg. F. and outlet 745 deg. F., and gas temperatures 825 deg. F. inlet, and 450 deg. F. outlet.

Superheaters

The automatically-controlled MeLeSco superheaters were designed and manufactured by The Superheater Co. Ltd., to give a final steam temperature of 1,060 deg. F. at 1,600 lb./sq. in. over the range 760,000/950,000 lb./hr. In this range, the steam temperature is guaranteed at 1,060 deg. F. ± 15 deg. F.

MeLeSco spray-type de-superheaters are arranged between the superheater second-stage outlet and third-stage inlet headers. These connections are also arranged so that steam from the right-hand side flows to the left-hand side and vice versa, before entering the third-stage inlet header. The steam in the rear-half of this stage is in contra-flow with the gases, and in parallel-flow in the front-half.

The final steam temperature is automatically-controlled by the two intermediate MeLeSco spray-type desuperheaters previously mentioned. A considerable proportion of the superheater equipment was manufactured in Australia by the MeLeSco Manufacturing Co. Pty. Ltd., a subsidiary of the Superheater Co. (Australia) Pty. Ltd.

Draught plant

The draught plant for each boiler was supplied by James Howden & Co. (Australia) Pty. Ltd., and comprises two forced-draught, two induced-draught, and four secondary system fans. The F.D. units each have a capacity of 228,000 cu. ft./min. at 16.5 in. w.g., and 104 deg. F. They operate at a speed of 740 r.p.m., and are driven by 777 h.p. motors. The I.D. fans are each of 580,000 cu. ft./min. at 16 in. w.g., and 470 deg. F. They are driven by 1,870 h.p. motors at a speed of 740 r.p.m. The secondary system fans are each of 33,000 cu. ft./min. capacity at 4.2 in. w.g., at 450 deg. F. They operate at 970 r.p.m. and are driven by 38 h.p. motors. The Multi-Vortex type dust-collectors (four per boiler) were also supplied by James Howden & Co. Ltd., and are designed to handle a gas volume of 110,000 cu. ft./min. at 490 deg. F. Each unit comprises 132 primary cells and a 3-V centicell secondary-collector having 144 cells (24 wide × 6 deep).

The boiler mountings pipeline valves, etc., were supplied by Dewrance & Co. Ltd., and comprise Dewrance water-gauge assembly with bi-colour illuminated water-level indicators—these units being of fabricated construction with directly-deposited hard-faced seats in the steam and water shut-off valves; Dewrance consolidated full-lift type safety-valves; electrically-assisted superheater safety-valves; pipeline valves including a number of 9 in. bore, these being of the pressure-held cover type with which the fluid pressure is utilised to make an effective seal. Some of these valves are fitted with a Jones/Tate electrical actuator, either of the direct-on type, or pedestal mounted. A large number of Dewrance smaller-bore valves of the pressure seal type were also supplied.

The automatic boiler control and instrumentation equipment was supplied by the Australian branch of Bailey Meters & Controls Limited. The Bailey automatic control equipment maintains boiler steam pressure, and pressure suction, at the desired values; it also maintains the correct fuel/air ratio to allow for correct combustion conditions at all loads; drum water-level at the desired value, and the temperatures of the air and fuel mixture at the main mill outlets at the desired value. Remote manual control of auxiliary equipment associated with the above functions is also provided, especially for starting-up purposes and during emergency conditions.

Ash and dust-handling plant

The ash and dust-handling plant installed is of the Babcock Hydro-jet and Hydro-vac type. The coarse ash is collected in steel-framed hoppers with refractory linings, and is periodically removed through side feed chambers and discharged into a high-velocity sluice running along the length of the boiler house and terminating at a transfer sump. From there, it is pumped by vertical-spindle hydro-seal pumps to a waste area located about half-a-mile from the boiler house. The fine dust is collected in storage-hoppers beneath the various boiler auxiliary plant items, and is again periodically discharged by means of water-operated feeder ejectors into a second sluice which is of the gravity type. This sluice conveys the dust and water mixture from the feeder ejectors to the above-mentioned ash transfer sump, and the mixture is then disposed of by the same pumping equipment to the disposal area.

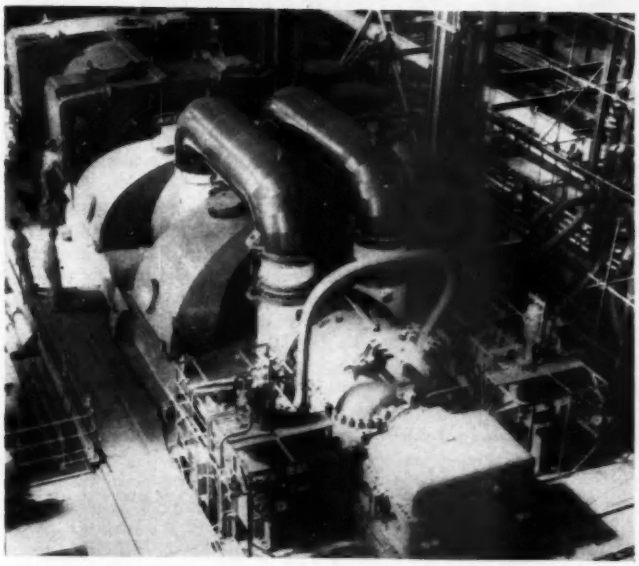
Generating plant

The two A.E.I. 120-MW steam turbine-generators, which are being installed, are non-reheat machines running at 3,000 r.p.m. The turbines are two-cylinder units designed for operation with stop-valve inlet steam conditions of 1,500 lb./sq. in., 1,050 deg. F. The high-pressure cylinder contains a velocity stage followed by 16 single impulse stages. The casing has an inner shell of cast molybdenum-vanadium steel extending over the first eight impulse stages, the pressure between this shell and the outer casing being that obtaining at the eighth stage. The outer shell is of ½ per cent. molybdenum cast-steel at the inlet end, and cast carbon steel at the exhaust end. The rotor is machined from a monobloc forging of ½ per cent. molybdenum steel with

integral discs, and it is carried by two spherically-seated white-metalled journal bearings, that at the inlet end being combined with a Michell-type thrust bearing.

The two-flow low-pressure cylinder, with central steam inlet, has four single impulse stages and a Baumann multi-exhaust in each flow. The governing controls follow A.E.I. practice for large high-speed sets, and are operated by a gear-driven horizontal governor in the high-pressure end pedestal.

The steam exhausts from the low-pressure casing into a twin-shell fabricated steel surface condenser of A.E.I. design. This was manufactured in Australia by Thompsons (Castlemaine) Limited. It is of central-flow design with a total cooling surface of 67,000 sq. ft. and the water side is arranged for annular three-flow. The condenser will maintain a vacuum of 28.5 in. Hg. at the 120-MW E.C.R. when supplied with 2,340,000 gal./hr. of cooling-water at a temperature of 58 deg. F. Each condenser is equipped with two 100 per cent. air-ejectors of Thompson design and manufacture, one being a reserve unit.



One of the two A.E.I. 120-MW non re-heat turbine-generator sets at Yallourn "E" during the final stages of erection.

The feedwater heating equipment, supplied with steam extracted from the turbine, was manufactured in Australia by Thompsons, to A.E.I. designs. It consists of a drain flash condenser, No. 1 low-pressure heater, gland heater, No. 2 low-pressure heater, vent condenser-deaerator, and three high-pressure heaters. The design final feedwater temperature is 420 deg. F.

Generator

The generator, direct-coupled to the turbine, is rated at 150-MVA, 0.8 p.f., and it generates three-phase, 50 c/s alternating current at 13.8 kV. It is hydrogen-cooled with a gas pressure of 30 lb./sq. in. In addition, the generator is capable of a maximum rating of 157.5-MVA at 0.8 p.f., when cooled by hydrogen at 45 lb./sq. in. The stator is of welded-steel construction with two vertical hydrogen cooler tube nests carried in each end-enclosure. The windings are of involute form, and the end windings are secured against movement on short circuit by clamps and supports. The rotor is made from a solid forging, with slots machined in it for the windings, and subsidiary slots in the rotor "teeth" for ventilation.

A main exciter for the generator field is gear-driven from the generator-shaft; excitation of the main exciter field being supplied by a pilot exciter directly-connected to the main exciter.

Water-treatment plant

Make-up water for the high-pressure boilers is treated by a Permutit mixed-bed "Deminrolit" plant designed and supplied by The Permutit Co. Ltd., to deal with 6,000 gal./hr. of make-up water. The plant comprises two 5 ft. dia. mixed-bed Ion exchange units containing intimately-mixed cation and anion resins. When the water passes down through these resins, ionised solids in the water are removed. After treating their rated capacity, the two mixed-bed units are regenerated with acid and caustic soda. The plant is fully-equipped with vacuumatic acid-regeneration gear which enables acid to be drawn from the storage, measured and diluted, and injected into the mixed-bed units without manual handling. Regeneration equipment is also provided for injecting the caustic soda, and to indicate the quality of demineralised water produced by the plant, Permutit conductivity testers are provided.

PLANT AT MORWELL

The Morwell undertaking, to produce electricity and briquette fuel, is the State Electricity Commission's second major development of Victoria's brown-coal deposits in the Latrobe Valley, and is some 90 miles east of Melbourne. Recent experimental work on the production and utilisation of coke from brown-coal briquettes indicates the possibility that brown-coal coke may eventually compete with black-coal coke for metallurgical and industrial use. All the briquettes and raw brown-coal used in the gas-works established at Morwell by the Gas and Fuel Corporation of Victoria are supplied by the State Electricity Commission. These gas-works have been operating since 1956, fuel in the early stages coming from Yallourn. Electricity production in the State Electricity Commission's Morwell undertaking began at the end of 1958, and output for general supply has progressively increased with the installation of additional generating plant. Morwell Power Station is designed to perform three functions:—it generates electricity for public supply, it provides large quantities of low-pressure steam in the briquette works to dry the moist raw brown coal before it is compressed into briquettes, and it also provides the large amount of power needed to operate plant in the open-cut and the briquette works. Each of the coal-winning dredgers alone uses as much power as would be required by a small town. By 1963, about 83 per cent. of the output of the power

station will be available for public supply. The station is designed to operate on raw brown coal from the open-cut. This coal is crushed in hammer mills and delivered to the boiler house. Here, it is crushed again to a powdery consistency, dried by flue gases from the furnaces, mixed with air, and blown into the furnaces to be burned in suspension. The boilers are equipped with dust-collectors of the most modern design, and 300 ft.-high chimneys disperse over a large area, such fine dust as may escape the collectors, thus minimising any dust nuisance.

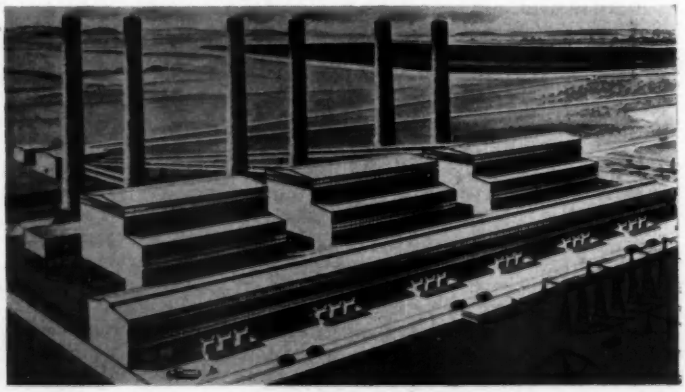
About two-thirds of the exhaust steam from the turbines of the three 30-MW machines is used in the briquette works for drying moist raw coal. The drying process fully condenses the steam, and the resulting water is returned to the boilers as feedwater. The remainder of the exhaust steam is used to generate electricity in the 20-MW low-pressure turbo-generator set, and then passes to condensers, and so back to the boilers as feedwater. The 60-MW turbo-generator set, scheduled for commissioning in 1963, will have a normal condenser to convert exhaust steam into water for return to the boilers, in a continuous cycle of operations. The Morwell boiler units were supplied by Mitchell Engineering Limited, London, five units have so far been installed. Each boiler has an evaporative capacity of 235,000 lb./hr., steam conditions at the superheater outlet being 1,300 lb./sq. in. and 932 deg. F. The nett calorific value of the brown coal is 3,470 B.Th.U./lb. and it is pulverised in Kramer impact mills, of which there are four per boiler. The superheaters are of the MeLeSco type and were manufactured and supplied by the Superheater Co. Ltd. The air-heaters are of the Mitchell tubular type, and the economisers of the plain steel-tube type supplied by E. Green & Son Ltd., Wakefield. The ultimate generating plant will comprise one 60-MW, three 30-MW and one 20-MW turbo-alternator sets—the latter being designed to operate with low-pressure steam. At Morwell, electricity is generated at 11-kV, but transformers step up the output to 66-kV, this to be increased later to 220-kV, for distribution, via Yallourn, to terminal receiving stations in the State supply system.

New Hazelwood project

The new Hazelwood Power Station, located south of the Morwell open cut, will have an ultimate capacity of 1,200-MW. It is designed to meet Victoria's increasing electricity requirements after completion of present extensions at Yallourn and Morwell. Development of Hazelwood is in accordance with the Commission's long term aim to generate the bulk of its electricity—the base load—in large steam power stations located close to the brown coal-fields of the Latrobe Valley, and burning low-cost raw brown coal—as is now done at Yallourn and Morwell. The output of this new base-load station will, as previously mentioned, be supplemented by a progressively increasing output of peak-load power transmitted from the Snowy Mountains hydro-electric undertaking.

Hazelwood will be built in stages, for completion about 1971, the first stage capacity being of 400-MW. Preliminary site work began in 1959. The turbo-generators will each be of 200-MW capacity and the first of these is due to be in service in 1964, with the second, following a year later. Electricity generated in Hazelwood Power Station will be transmitted at extra high voltage to terminal receiving stations in Melbourne, for distribution through the State supply network. Annual fuel consumption will rise progressively to about 13 million tons when Hazelwood is complete. A notable feature of the Hazelwood scheme will be a large artificial lake, 2½ square miles in area, to provide cooling-water for the turbine condensers.

The two boiler units so far ordered for Hazelwood are to be supplied by Babcock & Wilcox of Australia Pty. Limited, and the first two 200-MW generating sets by Australian Electrical Industries Pty. Limited. Roughly, 70 per cent. of the plant and associated equipment will be manufactured in the United Kingdom, and the remainder in Australia. The Babcock boilers for the first stage will be two non-reheat unit boilers of the radiant natural circulation type, each designed for an m.c.r. of 1,650,000 lb./hr., with steam conditions of 1,600 lb./sq. in. and 1,055 deg. F. at the superheater outlet. Feedwater temperature at the economiser outlet will be 420 deg. F. Each unit boiler will be complete with all ancillary equipment, including main brown coal and auxiliary briquette pulverising-mills and burners, gas lighting-up equipment, superheaters and attemperators, economisers, air-heaters, electrostatic precipitators, induced and forced-draught fans, chimneys, bunkers and coal feeder conveyors, furnace and superheater soot-blowers, shot-cleaning for economisers and airheaters. The boiler arrangement will be that usually referred to as semi-outdoor, in which only the plant below the feeder conveyor level and within the boiler structure limits will be completely weatherproofed. The upper-levels, including the steam-drum and above, will be provided with a weatherproof cap. Bunkers and plant in the bunker annexe will be closed in with sheeting; air-heaters, precipitators and fans at the rear of the boiler



Artist's impression of the new Hazelwood power station which, when completed in 1971, will have an installed generating capacity of 1,200-MW, and will operate on raw brown-coal from the Morwell open-cut.

will not be enclosed. The furnace is of tangent-tube steel-cased construction, and the whole will be freely suspended at the top from the structural steelwork. Each boiler will be provided with eight p.f. mills—the capacity of the mills being such that seven of them will be capable of serving the boiler, under full-load conditions. There will also be two auxiliary mills per boiler for crushing brown coal briquettes to be used for lighting-up purposes. Coal consumption per boiler will, it is estimated, be of the order of 300 tons/hr. It is anticipated that the boilers will operate for long periods at m.c.r., and in view of this, " on load " cleaning equipment on an appreciable scale will be provided. Ash-handling and disposal will be of the hydraulic type, including high-pressure nozzle-assisted sluice-ways from the plant hoppers, and pumping to an adjacent disposal area, from which the carrying water will be drained to a special pond and thence re-circulated to the disposal pump system. Each boiler and associated turbo-generator will operate as a unit without any interconnection of main steam or feed piping with other units. The first unit boiler is expected to be in service in March, 1964.

Generating plant

The turbines for the 200-MW sets will be single-shaft machines of the three-cylinder impulse type, with three exhaust flows to the condenser each incorporating a multi-exhaust stage. Provision will be made for the extraction of steam to permit of bled steam feedheating in five stages. There will be two low-pressure heaters, twin deaerators, and two twin high-pressure heaters. Twin two-pass condensers will be supplied for each unit. Circulating-water will be provided from the large artificial cooling lake referred to previously. This lake will be created by building a dam and earth-work embankment and flooding a natural depression to the south and south-west of the station. Two circulating-water pumps will be provided with each unit, and will supply approximately 4½ million gal./hr. The generators will be of the hydrogen-cooled type with direct-cooled rotor windings and water-cooled stator windings. The hydrogen pressure will be 30 lb./sq. in. Continuous maximum output of each generator at rated voltage 16.5-kV, rated frequency 50 c/s and at 0.8 p.f. will be 250-MVA. The overall cost of the first stage of the Hazelwood project will be approximately £31 million. This is about £3½ million lower than anticipated, and includes the cost of the civil engineering works, the artificial lake, buildings, coal-handling plant, and the station transformers and switchgear.

In conclusion, we record our indebtedness to the State Electricity Commission of Victoria for granting us permission to publish this article and for supplying some of the statistical and general information.

A New Flow Controller

A new device for controlling the flow of liquid through a pipeline at a constant pre-set rate, irrespective of pressure fluctuations, has been recently introduced by The Permutit Co. Ltd. This controller, known as the " Pervo " is claimed to have many advantages over existing controllers of the venturi type:—the design avoids the use of packed glands, diaphragms and loaded beams ; response is consequently smooth, positive and quick and accurate control is obtained over the entire flow range. The " Pervo " is available in straight-through or angled patterns in a number of standard sizes. Rate setting can be direct-manual, remote-manual or fully-automatic, and a slow start attachment can be provided for filter applications.

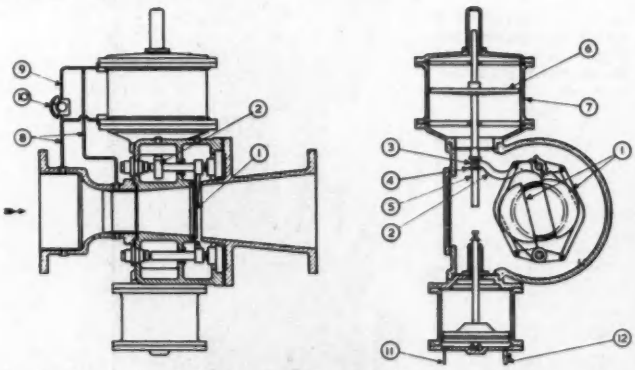


Fig. 1 (above). Longitudinal and cross-sectional line arrangements showing, in simplified form, the Permutit " Pervo " flow controller.

Fig. 2 (right). General view of controller.

The main components of the " Pervo " flow controller are the venturi section, a pair of linked and balanced valve gates downstream of the venturi throat, and the actuating mechanism. The outline arrangement, Fig. 1, shows the controller in simplified form. The valve gates 1 are operated by a lever 2. Attached to the free end of this lever is roller 3, which engages with the collars 4 fitted to the piston rod 5. The piston rod is guided by bushes, and carries piston 6 inside the actuating cylinder 7. Clearance is allowed between piston and cylinder barrel to prevent friction during movement of the piston. Connecting pipes 8 lead from the upstream and throat tappings of the venturi to the bottom and top of the actuating cyclinder ; differential pressure created during flow through the venturi is thereby transmitted into the actuating cylinder, and thus to the piston. These pipes are connected by the by-pass 9, fitted with an adjustable rate-setting valve 10. This valve produces a predetermined differential across piston 6 that remains constant, irrespective of change in differential in the venturi caused by variations in flow ; the weight of the piston and its associated moving parts is balanced by the upward thrust created by the differential across the piston. With no flow through the venturi, there is no differential, and

piston 6 remains at the bottom of its stroke. The valve gates are then fully open.

When flow commences, a differential is created in the venturi, and this is transmitted to the actuating cylinder. The piston is then forced upwards, causing the valve gates partially to close. Flow through the venturi is thus throttled, and a state of equilibrium is reached as determined by the rate-setting valve. If the flow tends to drop, the differential in the venturi is reduced. The piston consequently falls, causing the valve gates to open, and flow is again restored to the pre-set rate.

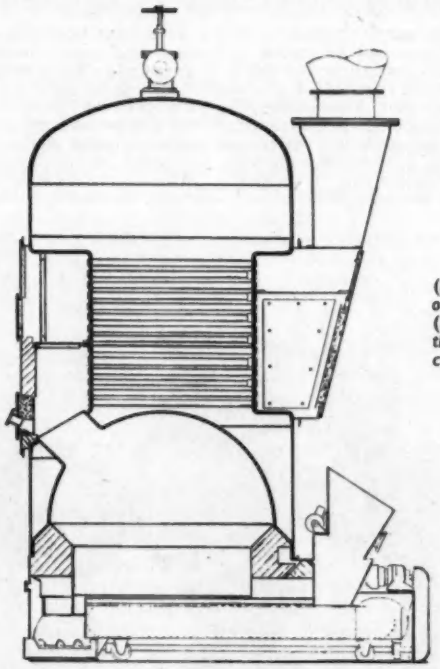
After a gravity sand filter has been washed, it is usually brought back on load slowly; with the "Pervo" controller, an automatic slow start mechanism can be provided. This consists essentially of an auxiliary cylinder and piston vertically-opposed to the main actuating cylinder. When pressure water is admitted through 11 to the auxiliary cylinder, the piston rises and locks the actuating piston in the upper position; the valve gates are thereby closed and flow stops. Pressure in the auxiliary cylinder is then exhausted at a predetermined rate through an adjustable bleed 12, allowing the valve gates to open slowly until normal load conditions are restored. This form of slow start control has many advantages over previous practice. The duration of the slow start period is accurately adjusted, response is smooth and positive, and the use of clumsy fluid counterweights is avoided.

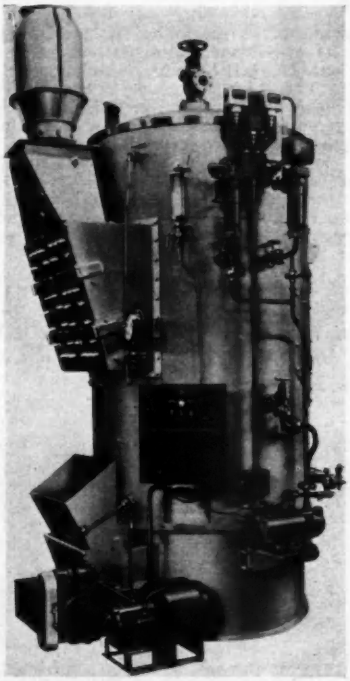
Standard "Pervo" controllers are suitable for flows varying in the ratio 1 to 4; accurate control being obtainable throughout the whole of this range. They can be provided with the following rate-setting attachments: (a) Direct manual, in which the rate-setting valve, attached to the controller, is provided with a pointer operating against a calibrated scale. (b) Direct manual, with slow start, in which case the controller has the integral rate-setter, and the adjustable slow start control. (c) Remote manual, an arrangement which allows all filter controls to be grouped on a control table. Actuation can be by cable and pulleys, or other mechanical or hydraulic means appropriate to the plant design. (d) Fully-automatic and where the following features can be incorporated with Permutit automatic control systems:—(i) Automatic variable rate-setting, initiated, for example, from a level-sensing device. (ii) Automatic up-lift, whereby the controllers of individual filters are opened to maintain capacity whilst other filters are off-load.

Coal-Fired Packaged Boilers

Cochran & Co. (Annan) Ltd. has developed from its Series II vertical oil-fired packaged boiler, which was introduced in 1959, a new range of vertical, multi-pass, coal-fired packaged boilers. These, known as the "Coal-Fired Series II," have the same efficiency and evaporation as the oil-fired unit of the same capacity, an efficiency of 80 per cent. on the gross calorific value being claimed, in addition to being economical in running costs. The range comprises 11 unit sizes.

The boilers are suitable for high or low-pressure hot water applications, and coal-fired evaporation is independent of the quality of the fuel. The unit is of all-welded construction and is fitted with a special chain-grate, which incorporates principles developed by the British Coal Utilisation Research Association, and which gives smokeless combustion with a wide range of coals, and has a turn-down ratio (4 : 1) at least equal to that of oil. An induced-draught fan is also provided, there is a compact and efficient ashing arrangement, and the boiler can, if necessary, be provided with comprehensive automatic boiler control equipment. Withdrawal of the complete stoker unit for inspection and maintenance is comparatively simple since the chain-grate is floor-mounted on rollers run in channel irons. Ash is discharged to the far end of the boiler either directly into a barrow contained within the boiler skirt or into a hopper from which it can be extracted by a screw conveyor. The outstanding feature of the boiler is that it can accommodate an oil-burner at the same time as the chain-grate, so that dual firing is possible. If adaptation of the original Series II oil-fired burner is required, the only modifications necessary are the lengthening of the boiler skirt by 1 ft. 9 in., the additional bricking-in of the furnace, and the mounting of an induced draught fan. In accordance with packaged boiler practice, the new Series II coal-fired boiler is supplied fully mounted and complete with all accessories—the chain-grate being installed on site.





(Left). Cross-sectional outline arrangement and (right) general view of the new Series II Cochran coal-fired packaged boiler.

Automatic Leak-Off Device for Boiler Feed Pumps

BOILER feed pumps may be damaged as the result of overheating if they have to operate for any length of time at inadmissibly low deliveries. To guard against this contingency, Sulzer Brothers have developed, in collaboration with Sauter AG., of Basle, a new automatic leak-off device which employs no stuffing-boxes and has a control system entirely free of contacts. This device offers a maximum of dependability with a minimum of maintenance.

When the delivery of a centrifugal pump is throttled, the power input is reduced until, when the discharge valve is completely closed, it is only from 30 to 60 per cent. of the nominal input, according to the type of pump. This residual input is now converted into heat in the pump much as in a hydraulic brake and shown graphically in Fig. 1. There results, of course, a certain rise in temperature between the inlet and outlet of the pump at all deliveries, and Fig. 2 shows graphically the characteristic of this temperature rise as a function of the delivery. At extremely low deliveries, the heat developed soon causes vaporisation of the delivery medium and may result in severe damage to the pump.

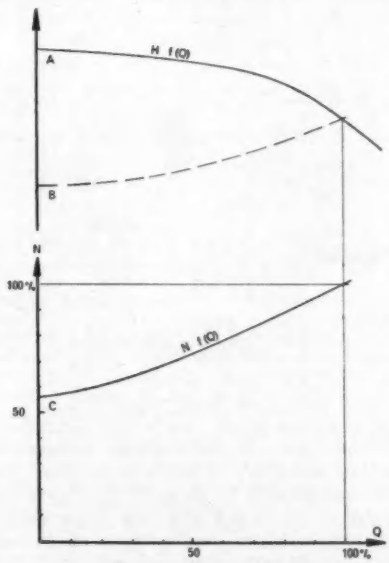


Fig. 1. Pump characteristic curves.

A—Pump characteristic, H = f(Q).
B—Boiler characteristic.
C—Input characteristic, N = f(Q).

Boiler feed pumps are particularly susceptible to this trouble, as their delivery sometimes has to be reduced to very low values to suit the load of the boiler. This is done either by throttling the feed-valve or by reducing the speed of the pump.

Where variable-speed pumps are operated in parallel, it may also happen that the respective speeds of two pumps diverge somewhat, so that uneven loading ensues. In extreme cases, the delivery of the slower running pump may even fall to zero.

An undesirable increase of temperature may also occur when boiler feed pumps are being started up or shut down, in so far as this operation takes several minutes to complete. The simplest means of preventing damage from unduly low deliveries is to provide a constant-flow by-pass system. This is doubtless the best arrangement for small sets (up to an input of about 100 h.p.), as it is reliable, simple and cheap. For large units, however, the method is uneconomical as a rough calculation will show. In order to deliver, say, one litre per second (2.12 cu. ft./min.) against a pressure of 250 kg./cm.², (3,555 lb./sq. in.) an input of about 40 h.p. must be provided. As the lowest admissible deliveries range from 1 to 15 l./s., 2.12-31.8 cu. ft./min., according to pump size, it follows that from 40 to 600 h.p. would be required only for the by-pass system. In addition, the wear on the throttle plates would be increased. Consequently, recourse must be had to a controlled by-pass system, or automatic leak-off.

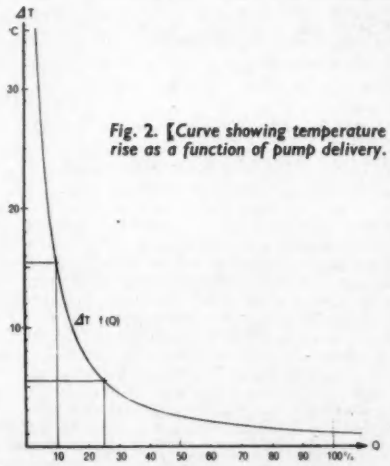


Fig. 2. Curve showing temperature rise as a function of pump delivery.

Principle of operation

In principle, a leak-off may be operated in either of two ways:—(a) as a function of the temperature rise of the medium delivered; (b) as a function of delivery. In this case alternative (b) was chosen, as it offers the

advantage of responding to the cause of the trouble and not merely to its effect, the rise in temperature. Flowmeters also involve much less time lag than the naturally sluggish measurement of temperatures.

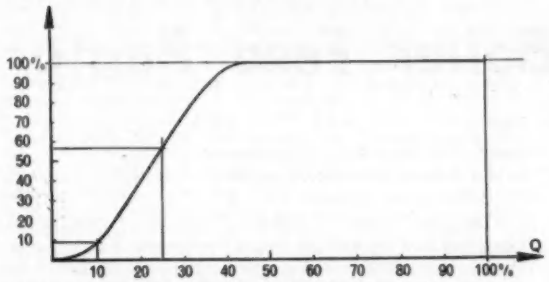


Fig. 3. Graphical representation of the opening of the non-return valve as a function of flow.

Venturi flowmeters provided for every pump, however, would be very expensive. They also have the disadvantage that the △p-curve is very flat at small flows, which would impair the accuracy of measurement precisely in the range which is of primary importance.

Fortunately, there is an alternative. The position of the flap of the non-return valve also furnishes a measure of the flow, and this indirect measurement has the added recommendation of being very accurate at small flows (Fig. 3). The obvious expedient would, therefore, seem to be the operation of a leak-off valve directly from the non-return valve. The gate-type valves which would have to be used for this purpose, however, are subject to heavy wear, and have a tendency to stick. It was, therefore, decided to replace them by a specially-designed needle valve with a servomotor for indirect control.

The position of the non-return valve flap is measured by induction with the aid of feeler coils as indicated in Fig. 4. This makes it unnecessary to use glands—an advantage which greatly increases reliability in service, while simplifying maintenance.

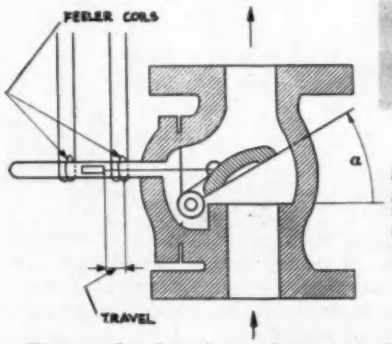


Fig. 4 (left). Diagrammatic sectional arrangement of non-return valve with feeler coils.

Design

A pneumatic leak-off device as used for pressures up to 250 kg./cm.² (3,555 lb./sq. in.) and leak-off flows up to 9 l./s., (19 cu. ft./min.), is shown in Fig. 5. Oil-operated units are needed for higher pressures and flows. The basic diagram, however, remains the same, and the only changes are in the leak-off and solenoid valves. Robust, non-ageing components without any contacts were necessary to ensure reliability even under very difficult conditions—the equipment installed in boiler-houses is often exposed to heat, dust and vibration. Collaborating with Sauter AG., of Basle, Sulzer Brothers have developed a control system with a magnetic amplifier which is claimed to satisfy all these conditions.

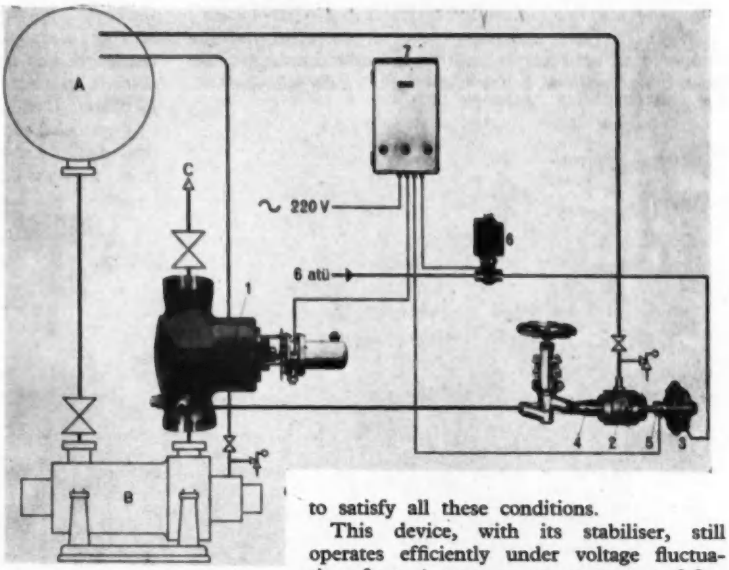
This device, with its stabiliser, still operates efficiently under voltage fluctuations from + 15 to — 20 per cent., and frequency fluctuations of + 5 per cent. It is heat-resistant up to 80 deg. C. (176 deg. F.), (the feeler coils up to 200 deg. C.) (392 deg. F.), while all parts are drip-proof and suitable for use under tropical conditions.

Fig. 5 (right). Basic hydraulic-electric diagram.

Key:—

A. Feedwater tank.
B. Boiler feed pump.
C. Boiler.

1. Non-return valve with leak-off branch, non-magnetic pressure-resistant steel tube, feeler coils and protective housing.
2. Leak-off valve with compressed-air servomotor 3, throttle 4 and signal contact 5.
3. Compressed-air servomotor.
4. Throttle.
5. Signal contact.
6. Solenoid valve (glandless three-way valve with magnet for 50 V = 15 watt).
7. Control unit with voltage stabiliser, magnetic amplifier, automatic fuse, manual control button, signal lamp (control voltage 220 V).



Method of operation

A basic electric diagram is shown in Fig. 6. The voltage stabiliser, which is normally placed ahead of the control unit and likewise has no contacts, has been omitted in order to simplify the diagram. Each opening angle of the valve flap corresponds to a definite rate of flow. The diagram in Fig. 3 shows the curve for this function. A magnetically conducting core is attached to the valve flap through a movable control rod and enters a non-magnetic, pressure-resistant tube fitted on the valve

to a greater or smaller depth, according to the opening angle of the valve (Figs. 4 and 6). The feeler coils can be moved on the tube, and must be adjusted in accordance with the diagram (Fig. 3), which is obtained by measurement. When the opening angle is small (sector Y of Fig. 6), the armature enters the right-hand induction coil only, while at large opening angles (sector X) it enters the left-hand coil only. The resulting increase in the inductivity of one of the coils controls the leak-off valve by way of the magnetic amplifier in accordance with a fixed programme. When the flow is severely throttled and the delivery, therefore, small (valve flap in sector Y), the solenoid valve is not energised, the compressed-air drive is without pressure and the leak-off valve, therefore, opens. For normal operation to be restored, the delivery must rise until the valve flap enters sector X. The solenoid valve is then energised, the compressed-air drive is put under pressure and the leak-off valve closes. When the opening angle lies in sector U, the operating state remains unchanged.

If the auxiliary voltage should fail, the solenoid valve is not energised, the compressed-air drive, therefore, loses its pressure and the leak-off valve opens. If the compressed-air supply should fail, the drive again loses its pressure and the leak-off valve opens. An auxiliary contact on the leak-off valve causes a signal lamp to light when the valve is open, while a push-button on the control unit permits the leak-off process to be initiated by hand.

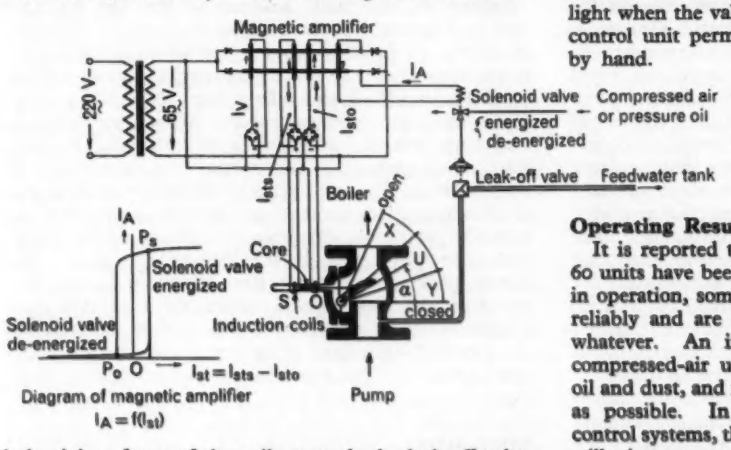


Fig. 6. Diagrammatic outline arrangement showing basic components, etc., forming electrical circuit.

Operating Results

It is reported that up to the present, a total of about 60 units have been ordered, of which over 30 are already in operation, some of them since 1957. All are working reliably and are claimed to have required no attention whatever. An important point is the quality of the compressed-air used. This air must be free of water, oil and dust, and its pressure should be as nearly constant as possible. In stations employing pneumatic boiler control systems, the compressed-air used for these systems will, in any case, satisfy the requirements. Where other control systems are employed and the compressed-air is, therefore, untreated, the installation of a pressure-reducing station with a separator and filter ahead of the leak-off device has been found to give absolutely satisfactory results.

Generally speaking, the principle of indirect control as a function of the position of the valve flap has been a success, and the contact-free design has permitted smooth operation even under the most arduous conditions.

OPPORTUNITIES FOR CHEMISTS AND CHEMICAL ENGINEERS AT ALBRIGHT & WILSON LTD.

It is reported that in the last 10 years, British chemical production has been doubled. This represents a rate of growth probably more than twice that of manufacturing industry as a whole. This expansion is due not only to increased demand for existing chemicals but also, and more significantly perhaps, to the development of a wide range of fundamentally new products and processes. The development of new chemicals and their translation into products of industrial importance depends greatly upon the quality of the industry's scientists and technologists and the facilities available to them. In addition to the large sums they are devoting annually to new plants and equipment, most of the larger chemical companies are investing heavily in scientific manpower and in the modern research tools necessary to their work. **Albright & Wilson Limited** have just published a new illustrated booklet addressed to recently-qualified chemists and chemical engineers seeking a career in industry. The booklet stresses that industry offers chemistry and chemical engineering graduates exceptional opportunities at present. Sections of the new booklet describe four of the largest manufacturing companies in the A. & W. Group—Albright & Wilson (Mfg.) Ltd., A. Boake Roberts & Co. Ltd., Midland Silicones Limited and Marchon Products Limited—and the nature of the opportunities they offer to science graduates. They indicate the scope of the research, technical service and other departments of each company and describe the sort of work a graduate will undertake on appointment. Other sections include notes on further education and training schemes operated by the Group and on conditions of employment. The booklet points out that " Young graduates are given every encouragement to equip themselves for a progressive and satisfying career in the Albright & Wilson Group. Owing to the rapid growth and increasing diversification of the Group, senior positions frequently become available and are filled whenever possible by promotion from within. Promotion is based solely on merit, which includes not only qualities of character and temperament and the necessary technical qualifications, but also administrative gifts and the ability to work in a team. Science graduates have especially good chances of rising to the highest positions in the Group, and science and technology are strongly represented on the boards of the holding and subsidiary companies. This booklet has been prepared as part of Albright & Wilson's continuous campaign to attract graduates of a high standard to their laboratories and technical departments. Copies have already been sent to university appointments boards, technical colleges, etc.

The General Electric Co. Ltd. has received an order, valued at more than £8 million, from the Central Electricity Generating Board, for the supply of four 350-MW turbo-alternator sets for installation in the new Tilbury " B " power station. Each 3,000 r.p.m. turbine will be of the tandem compound type, having operating steam conditions at the turbine stop-valve of 2,300 lb./sq. in. and 1,050 deg. F., with reheat to 1,050 deg. F., and exhausting to a vacuum of 28.9 in. Hg. Generation will be by 20-kV, and the alternators will have water-cooled stator windings and direct hydrogen-cooled rotor windings. The first two turbo-alternator sets are scheduled for commissioning in 1965, and the remaining two in 1966. The new station will be situated adjacent to Tilbury " A " station on the north bank of the river Thames.

Plant for two 2,000-MW Power Stations

ORDERS to a total value of £67 million are being placed by the Central Electricity Generating Board for steam and power generating plant to be installed in two new 2,000-MW power stations. As mentioned in the March issue of this journal, the Board recently indicated its intention to place orders for plant for the first of these two stations, which is to be built at West Burton, Notts., about two miles south of Gainsborough. The orders for both the boiler plant and the turbo-alternator plant for each of these stations represents the four largest single orders for such plant ever placed in Britain. The stations will, when completed, each have an installed generating capacity greater than that in any power station in Europe. The boiler plant for West Burton, valued at approximately £19 million, will be supplied by International Combustion Limited and Simon-Carves Limited. The generating plant, which will comprise four 500-MW turbo-alternator sets, will be supplied by the English Electric Co. Ltd.—the total value of this contract being about £15 million. The first turbo-alternator/boiler unit is scheduled for commissioning by June, 1965, and the completed station should be in full operation by the end of 1967.

Boiler plant

It will be recalled that International Combustion Limited and Simon-Carves Limited, announced during October last, that they had decided on a measure of integration and closer association of the two organisations, which would be applied especially in the technical fields. The responsibilities for the carrying out of the present West Burton contract have been mutually agreed by these two companies, and using the technical facilities of each organisation best suited to each section of the contract.

The design of the reheat boiler units for West Burton represents a natural development of that adopted for the 550-MW International Combustion boiler unit for Thorpe Marsh power station, ordered in 1959. The units which are of the controlled circulation type, will be skin-cased and arranged for cubic expansion down to the economiser outlet. Each boiler will be constructed with a single sub-divided furnace employing tangential firing of the fuel from six pulverised-fuel mills of the pressure type. Five mills will be capable together of carrying the full load of the boiler, thus leaving one mill in reserve for stand-by purposes. Each of the four boilers will have a capacity of 3,450,000 lb./hr., the steam pressure and temperature at the superheater outlet being 2,400 lb./sq. in., and 1,055 deg. F. respectively, while the reheat steam temperature will be 1,055 deg. F.

Turbo-alternators

Each of the four English Electric 500-MW turbo-alternator sets will comprise a three-cylinder, 3,000 r.p.m. turbine with multi-exhausts arranged as a tandem compound unit coupled to a hydrogen/water-cooled alternator of the direct-cooled type. Solid couplings will be employed between each rotor, and each shaft will be mounted on two main bearings so that the assembly and maintenance of the machine are kept as simple as possible. As in all these large machines, efficient electronic supervisory gear with centralised control will be used for simplified and reliable operation. The steam conditions at the turbine stop-valve will be 2,300 lb./sq. in. and 1,050 deg. F., with reheat to 1,050 deg. F. The vacuum at maximum and continuous rating will be 28.7 in. Hg. The high-pressure cylinder will employ a double-casing arrangement over the first stages, with the expanded steam passing over the outside of the inner-casing to pass through the remaining stages. The intermediate cylinder will have a double-casing construction at its steam end, whilst the multi-flow low-pressure cylinder will have a double-flow arrangement. To allow for differential expansion, the nozzle plates and diaphragms will be mounted within the separate inner casings.

Alternators

Due to transport limitations, the weight of the heaviest component of the generator, namely, the inner stator, must not exceed 200 tons. Thus, the generator for this single-shaft set is designed with three main components—the rotor and the inner and outer stators, instead of the usual two.

The 3,000 r.p.m. alternator will be of the direct-cooled type with a maximum rating of 500-MW, and will generate at 22-kV. It is designed for a short circuit ratio of 0.4 and a power factor of 0.85 lagging. The rotor will be machined from a single forging, the inner stator frame will carry the core and windings, while the outer stator casing, which will be a welded-steel cylinder will carry the inner stator and the hydrogen coolers. The direct-cooling system will employ hydrogen at a pressure of 60 lb./sq. in. for the rotor conductors and for the stator core, and water for the hollow stator conductors. The hydrogen will be circulated by a multi-stage axial-flow blower mounted on the rotor shaft. The recooled gas will enter the conductors at each end of the rotor body to cool the solid and end windings separately. The stator core will be cooled by a separate stream of gas; all the hot gas flowing through the first-stage cooler, and thence to the blower intake. The blower will discharge through a diffuser to the second-stage cooler, from which the fully-cooled gas will re-enter the machine. The water for cooling the stator coils will circulate in a closed circuit, make-up water being drawn from the station de-mineralisation plant, while the hydrogen coolers will be fed with condensate.

Excitation for the 500-MW alternators will be provided by a direct-coupled exciter, the output of which will be converted by silicon rectifiers fed directly into the slip rings of the main alternator rotor. Control of the excitation will be obtained by means of a continuously-acting automatic voltage-regulator, which adjusts the rotor current of the exciter alternator.

Feed heating plant

Seven bled-steam stages will be employed for the feed-heating system, the h.p. heaters being arranged on the discharge side of the boiler feed pump. The latter will be driven by an auxiliary steam turbine of English Electric manufacture, and this company is also to supply the condensers and other items of the feed heating system.

Plant for second station

The orders placed by the Board for plant for the second 2,000-MW installation, the name and location of which have not yet been stated, have a total value of approximately £33 million. The order for the boiler plant, worth nearly £20 million, is to be placed with Babcock & Wilcox Limited. This plant will comprise four major boiler units each designed for a maximum rating of 3,500,000 lb./hr. of steam, at a pressure of 2,400 lb./sq. in. and a temperature of 1,055 deg. F. with reheat to the same temperature. Each unit will steam a 500-MW turbo-alternator set. All four units will be of the Babcock Radiant type, fired with pulverised coal. In accordance with recent arrangements between Babcock & Wilcox Limited and Yarrow & Co. Ltd., the resources of these two companies will be combined for the construction of this new boiler plant, thus making the most effective use of the respective technical and manufacturing facilities of the two companies, and also of the experience obtained by them over many years.

The four 500-MW turbo-alternator sets are to be supplied by C. A. Parsons & Co. Ltd. These four machines alone represent an equivalent increase of more than 6 per cent. in the total capacity of generating plant at present installed in the United Kingdom. The value of the order, which will include the associated feed-heating plant and turbo-driven boiler feed pumps, will be about £13 million. This new order will make a total of six machines of 500-MW capacity (and over) to be constructed by Parsons for service in this country and overseas. One of these, a 550-MW machine, was the first of such a size to be ordered in Great Britain, and is to be installed at Thorpe Marsh generating station near Doncaster, and it will be commissioned early in 1963. Another 500-MW machine of particular interest is at present under construction at Heaton Works of C. A. Parsons & Co. Ltd., for the Tennessee Valley Authority, for installation at the Colbert Steam Plant, U.S.A.; this machine will be the largest ever to be exported from any country.

The ordering by the C.E.G.B. of plant of this magnitude is an outstanding example of recent advances made in the technique of power generation. These large 500-MW generating sets will, it is claimed, result in an improved thermal efficiency (about 36 per cent.), and a reduction in the capital costs per kW of plant. Estimates of the costs of these sets are put at £40 per kW of plant installed, a reduction of 20 per cent. on the estimated average of £50 per kW in 1960.

JOHN THOMPSON INDUSTRIAL CONSTRUCTIONS LIMITED

John Thompson Industrial Constructions Limited ("Induscon"), a member of the John Thompson Group of Companies, Wolverhampton, have recently received two important orders for the supply of ash- and dust-handling plant for power stations. The first of these is an export order worth £463,540 (sterling), to supply equipment for Vales Point power station of the Electricity Commission of New South Wales, the station being located some 70 miles north of Sydney. The contract calls for the supply of hydraulic ash and fly-ash collection and disposal plant at the station, construction of which commenced in October, 1960, to allow for the first section of the boiler plant to be in commission by February, 1963. The ash-handling plant will be supplied by "Induscon," to serve boiler plant which is being supplied by International Combustion Limited. The generating sets will comprise three 200-MW and one 275-MW units, while the completed boilerhouse will probably contain four boilers, and will be built in two sections. In the first section, there will be four International boilers; the first three, which will steam the 200-MW sets, will each be of 1,350,000 lb./hr. capacity, and will operate at 2,450 lb./sq. in. and 1,055 deg. F., while the fourth unit will be of 1,850,000 lb./hr., with steam conditions of 2,400 lb./sq. in., and 1,055 deg. F. The estimated total of ash to be handled daily from these units will be in the region of 1,900 tons; the fly-ash should amount to about 350 tons per day. In addition, the plant will collect and dispose of Pyrites from 16 coal-pulverising mills in the station. Ash and fly-ash will be pumped from the station to disposal lagoons some 3,500 ft. away. The "Induscon" equipment will collect furnace ash from each of the boilers by a high-pressure, non-circulating sluicing system, and will convey the ash at 60 tons per hour. The ash-collecting hoppers under the boiler furnaces are to be supplied under the contract. They will have a capacity of 30 tons and will be of dry type, with bottom outlets. The fly-ash will be collected from the precipitation units by pneumatic suction, obtained by the use of hydraulic ejectors discharging into the gravity sluiceway. This ash will be handled at the rate of 180 tons/hr., while the Pyrites will be collected at the rate of 10 tons/hr.

The second of these important contracts received by the company is valued at £299,302, and is for pneumatic fly-ash extraction plant for boilers Nos. 4 and 5 in the extensions to the Kincardine power station of the South of Scotland Electricity Board. The plant will be similar to the ash-handling installation completed previously for boiler units 1-3, and is designed to remove fly-ash from the hoppers of the economiser, air heaters, mechanical collectors, etc., and to convey the ash to storage bunkers. In this installation the quantity of fly-ash made in 24 hours is about 250 tons, from each boiler unit. This amount is to be removed by the plant to the storage bunkers in a period of approximately 6 hr., and will then be pumped to disposal areas by the fly-ash disposal plant. The extraction plant will be sectionalised, each section associated with an individual boiler, and will comprise airflow conveyors which enable the fly-ash in the hoppers of the mechanical collector, the precipitators, and the intermediate collection bunker to be transferred to the surge hopper associated with a Kennedy Van Saun Automatic Pneumatic Transport Pump. The chimney hopper will be emptied of fly-ash directly to the main storage bunker by means of a jet feeder connected to the hopper outlet.

A supplementary order worth £70,212 is for hydraulic fly-ash disposal plant for boiler units numbers 4 and 5, and follows a similar installation provided by "Induscon" for units 1, 2 and 3. The initial installation was designed to handle the accumulation of fly-ash from the three 860,000 lb./hr. pulverised-fuel-fired boilers, but was so arranged that at a later date an extension could serve two further units each of 1,350,000 lb./hr. capacity. The total pumping time when handling slurry for the disposal of 780 tons of fly-ash from the two boilers, will be just under 4 hr. To this, has to be added a period for starting up, together with 1 hr. for purging after completion of slurry pumping, giving a daily plant operating time of 6 hr. Now, the extension plant to be put in by "Induscon" will run simultaneously with the existing plant, and will give a combined disposal rate of about 380 tons/hr. of dust. In addition to the above, important orders for Kincardine, John Thompson Industrial Constructions Limited, had earlier received a further order worth £48,789 to supply hydraulic furnace-ash-handling plant for the station. This plant will be very similar to that already installed for boilers 1, 2 and 3, and of the high-velocity water-sluicing type.

The Engineering, Marine, Welding and Nuclear Energy Exhibition

Air Control Installations Limited, *Victoria Road, Ruislip, Middlesex*

Among the exhibits on this company's stand will be air-filters of various types and sizes, including "Roll-O-Matic" and multi-dry filters; fans—including the "Adapta fan" and small blower-type fans; a marine-type air-conditioning unit and dust-control equipment. A feature of particular interest will concern the company's "Velovent" system of air-conditioning, which provides for heating, cooling, humidifying, or de-humidifying, by means of compact units which are supplied with pre-treated air and hot or chilled water from a central plant. The "Velovent" unit is made in a range of standard sizes and is normally installed beneath a window with the discharge grill located in a shelf which may run the length of the room.

Aiton & Co. Ltd., *Derby*

This well known firm of piping manufacturers will feature among their exhibits, a section of 30 in. bore steam main complete with roller support and insulation, this being representative of three new transmission lines which are to be installed over a route of two miles in length to convey steam from the bore-hole area to the power station being constructed under a New Zealand geo-thermal power project. Other exhibits will include examples of corrugated piping up to 18 in. dia. for Trawsfynydd nuclear power station, a selection of fabricated pipes in alloy and carbon steels, expansion fittings, and various examples of "Uniload" constant-load pipe supports. There will also be sectioned pipe models to represent "Corwell" pipe joints, butt-welded pipe joints, creased bends, and corrugated bends.

Albright & Wilson (Mfg.) Limited, 1, *Knightsbridge Green, London, S.W.1*

This company will be showing their range of specialist chemicals and processes, including the new Pyrobrite. They will also feature their design and installation service covering all types of automatic and manual plant used with their chemicals and processes. Of special interest will be the new Pyrobrite bath for copper plating. This is claimed to give far better results than any other method, and to provide fully bright deposits over a wide current density range. The bath has outstandingly good levelling characteristics and produces close-grained, smooth deposits, which do not fingermark or spot out. As leaders in chemical polishing, the firm will show their range of Phosbrite solutions for aluminium, copper and their alloys. These solutions are fast and inexpensive, producing a bright, highly-reflective finish even to the most intricate shapes. Plusbrite 155 and 156 chemical brightening solutions, imparting lustrous, non-specular surfaces to aluminium and its alloys will also be exhibited.

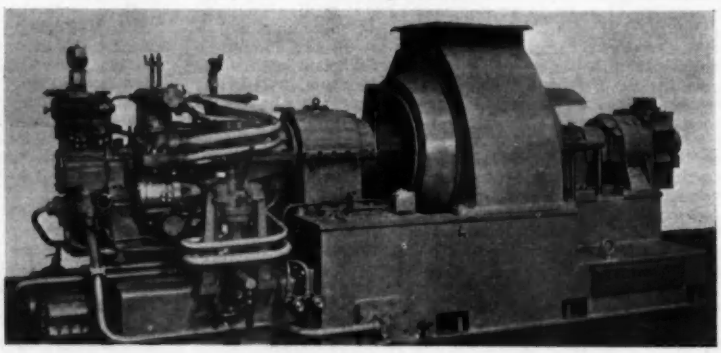
Alenco Limited, *Beacon Works, Hargrave Road, Maidenhead, Berks.*

The British Ermeto Corporation Limited, together with Simplifix Couplings Limited, both members of the Alenco group of companies, will exhibit a selection of high-pressure pipe couplings, valves and hoses from the Ermeto range of products. These include items from their new range of balanced stop-valves, and also examples of their extensive range of hose end fittings. The Simplifix exhibit will consist of tube fittings, prominent among which will be the new Simplifix coupling for nylon tube. Also to be shown will be examples from the wide range of Simplifix chassis lubrication fittings.

The 1961 Exhibition is being held at Olympia, London from 20th April to 4th May, and these notes review some of the exhibits—particularly those concerned with steam and power generating plant and associated equipment and auxiliaries.

W. H. Allen Sons & Co. Ltd., *Queens Engineering Works, Bedford*

The exhibits to be featured by W. H. Allen Sons & Co. Ltd., will be representative of the wide range of Allen power generating plant, pumping machinery and electrical equipment, which includes steam turbines, diesel engines, gas-turbines, steam engines, pumps (centrifugal, mixed- and axial-flow types), gearing, a.c. and d.c. electric generators and motors, and motor control-gear for marine, industrial and essential services. The largest exhibits will be a 750-kW marine-type back-pressure turbo-alternator, designed for tanker service, and a 250-kW diesel alternator set, comprising a five-cylinder, 428-r.p.m., 360-b.h.p. dual-fuel engine and self-regulating alternator together with control equipment. A centre of special interest on the Allen stand will be the upper-storey room where the company's latest sound film, featuring epicyclic gearing and entitled "For Mechanical Advantage," will be shown at intervals during each day. The waterworks pump to be exhibited is a 15/12-in., two-stage, single-suction, back-to-back unit of the horizontal split-casing type. It is designed for a variable output obtained by speed variation from an a.c. commutator motor with induction regulator. The maximum duty is 3,480 gal./min. (5 million gal./day) at 325-ft. head when running at 980 r.p.m. In addition to the 750-kW and 250-kW alternators coupled to the steam turbine and diesel engine, a third machine of this type to be exhibited, is a 550-kW brushless alternator of new design. This is a development of the conventional alternator/d.c. exciter combination, incorporating shaft-mounted rectifiers in place of the alternator sliprings and exciter commutator. The alternator itself is of normal construction except that no sliprings or brushgear are fitted. In addition to the epicyclic gear incorporated in the 750-kW turbo-alternator sets, two further epicyclic gear units will be shown independently. One is a speed-increasing gear unit for a motor-driven boiler feed pump, one of four similar sets for installation at Blyth "B" power station of the C.E.G.B. The unit is designed for transmitting 4,000 h.p. at 1,466/4,549 r.p.m. from a variable-speed slip-ring motor, the speed being infinitely variable down to half speed. Several similar epicyclic gear units are under construction for boiler-feed pump applications in various C.E.G.B. generating stations.



750-kW, marine-type, epicyclic-geared, back-pressure turbo-alternator. (W. H. Allen Sons & Co. Ltd.)

George Angus & Co. Ltd., *Newcastle upon Tyne,* 1

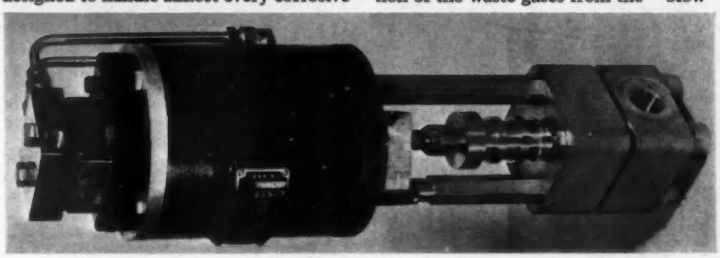
The main feature of the George Angus (Gear Division), stand will be the Angus hydraulic winch. These winches are powered by the Angus hydraulic transmission system, which enables the winch to be conveniently positioned without the restrictions imposed by conventional driving methods. Also to be shown is a range of standard double-helical reduction units suitable for transmitting horsepowers up to 300 with high input speeds. These units are particularly applicable in industries where high input speeds of pump or compressor drives are required. Also featured will be a range of light geared motors, one of these is a novel reduction motor which does not use conventional gears.

Associated Electrical Industries Limited, *Turbine-generator Division, Mosley Road Works, Trafford Park, Manchester* 17.

On this stand, most of the products of the Division, including steam and gas turbines, generators, heat-exchangers and marine machinery and associated plant, will be covered by the exhibits. Large steam turbines and generators will be illustrated by two giant coloured cutaway drawings; one of a large hydrogen and water-cooled generator, and the other of a steam turbine for nuclear power plant application. The generator is a 200-MW machine, one of two being built for the C.E.G.B. Willington power station, and similar to two for the Hazelwood power station of the State Electricity Commission, Victoria, Australia. The drawing of the steam turbine shows one of four 3,000-r.p.m. 83-MW mixed-pressure machines installed at Berkeley nuclear power station. A feature of these turbines is that they are designed to run on large quantities of steam at relatively low pressure and temperature conditions, and this calls for a large exhaust area which is achieved by means of the A.E.I. multi-exhaust system. The high-pressure steam enters the turbine at 310 lb./sq. in., and 604 deg. F.; after expansion through six turbine stages, it is mixed with low-pressure steam at 64 lb./sq. in. and 596 deg. F. The principal exhibit featuring industrial gas-turbines will be a model of the Gach Saran power station, recently built by A.E.I. for the Iranian Oil Exploration and Producing Company. The station houses three L51C gas-turbines, each driving a 5.5-MW salient-pole generator. They supply power for the operation of two distant oil-producing units, a water-pumping station and an adjacent housing estate. The station is completely self-contained and is not connected with any outside source of power. A 700-kW back-pressure marine auxiliary turbine-generator will also be shown. This machine has been designed to operate at steam conditions of 550 lb./sq. in. and 890 deg. F., and to exhaust at 31 lb./sq. in. into a low-pressure steam power system. The turbine has a two-row velocity-compounded stage followed by six single-row impulse reaction stages, and will run at 8,000 r.p.m. There will be a number of exhibits illustrating the wide range of condensers and heat-exchangers of A.E.I. design and manufacture for use in the electricity supply, petroleum, chemical and other industries. One of the most interesting parts of this display will be a demonstration of methods of tube to tube-plate fixing used in the A.E.I. heat-exchanger works at Petershill, Glasgow. Both automatic torque-control tube-expanding and automatic tube-end welding will be demonstrated.

Audco Limited, *Newport, Shropshire*

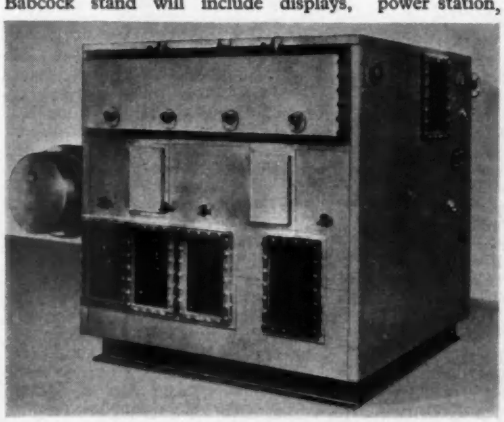
The equipment exhibited by this firm will include a selection of Audco lubricated taper-plug valves, manually, pneumatically and electrically-operated. They will be shown in various engineering and chemical engineering materials of construction, in sizes up to 24-in. bore and in a wide variety of pressure ratings. Also on show will be a selection of Audco control-valves, both manual and power-operated, developed for controlling hot, cold, erosive, corrosive or viscous fluids. These are manufactured in a wide range of materials, in sizes from ½ in. to 10 in. On show for the first time at this exhibition will be the range of P.T.F.E. sleeved plug-valves designed to handle almost every corrosive service without the need of maintenance. There will also be a new light-duty gear unit for easier operation of certain large wrench-operated valves. Examples of Audco level-gauge fittings and new valve lubricants will also be featured.



½ in. model 9460 stainless-steel Audco Annin control valve fitted with 600-series operator and integral positioner. (Audco Limited.)

Babcock and Wilcox Limited, *Babcock House, 209, Euston Road, N.W.1*

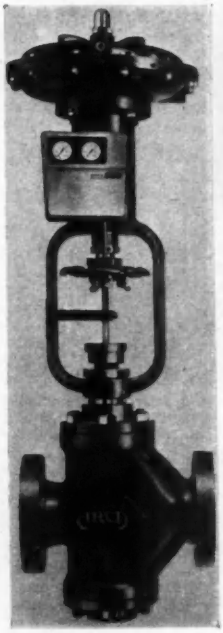
Exhibits of particular interest on the Babcock stand will include displays, relating to electronic computer control of boiler plant, with particular reference to the function and principle of operation of digital computer control as applied to one of the Babcock 200-MW boilers now being installed at the West Thurrock power station of the C.E.G.B., using the Ferranti Angus computer. This will be the first digital-computer controlled boiler in Europe. Development of central-station boilers to the present stage of a single boiler to serve a 550-MW turbo-alternator or to operate at supercritical pressure, with central-station thermal efficiencies of the order of 40 per cent., has followed the path of advancing steam technology and engineering. An animated display and a progressive series of models, all to the same scale, of typical central-station boilers of different periods, will indicate the development of central-station boiler units, in size, type and steam conditions over a period of some 70 years. A working model will demonstrate the new high-capacity Babcock coal-pulverising mill developed specially to meet the spectacular increase in the size and capacity of modern central-station boiler units. Another display will feature the utilisation of the waste gases from the "blow" of a Bessemer converter in a steelworks, for the generation of high-pressure saturated steam. Other exhibits will illustrate the experience of Babcock and Wilcox in the nuclear field over some 12 years. The contributions of the company will be shown, concerning a series of important nuclear power projects, from Calder Hall to the projected C.E.G.B. 580-MW Sizewell nuclear power station, including the design and construction of much major equipment such as reactor pressure-vessels and steam-raising plant, for both land and marine applications. Another display with working models, will show how Babcocks are widening their product range by taking advantage of expanded works facilities to manufacture specialised mechanical equipment for civil engineering, food, chemical and other industries.

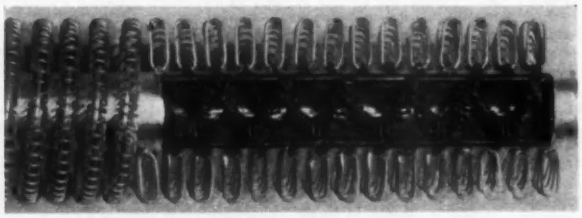


A typical Thermoflash 50-ton/day capacity marine distillation plant. (Bennis Thermoflash Limited.)

Bennis Thermoflash Limited, *Little Hulton, Walkden, Manchester*

Bennis Thermoflash Limited (member of the Hodgkinson Group of Companies) will include among their exhibits an animated diagram illustrating the operation of their Thermoflash distillation units for the production of fresh-water from saline water, together with a sectional model showing the design features which contribute to its reliability and ease of operation. The Thermoflash range of such plants varies from marine units, with fresh-water outputs from 5 to 150 tons/day, to the land-based units which are generally custom built for outputs up to 5,000,000 gal./day. A wide range of operating media can be employed, so that in every case, local conditions can be considered to ensure that any proposed installation would produce water at the lowest possible cost.





(Above). Part of a "Clayton-Still" heat-exchange tube specially designed for the cooling of oil, etc. (Clayton-Dewandre Co. Ltd.)

(Left). Electro-pneumatic positioner designed to enable pneumatic control-valves to be used with electrical controllers. (British Arca Regulators Limited.)

British Arca Regulators Limited, *Sisson Road, Gloucester*

British Arca Regulators Limited will be exhibiting some diaphragm-operated valves of single-seated and double-beat construction, together with a range of pressure, temperature and liquid-level controllers, which are new items, and are complementary to the valves. Among these controllers will be an electro-pneumatic positioner which has been designed to enable pneumatic control-valves to be used in conjunction with electrical controllers, and provides a linear relationship between operating current and valve stem regardless of valve unbalance forces. Also to be shown, is a relatively new paper stock consistency-regulator, a strip-chart and a disc-chart recorder. Solenoid, hydraulic and pneumatic valves of the two-, three- and four-way type will also be displayed, and these will be of the well-known Skinner, Allen Air, and Versa designs.

The British Rototherm Co. Ltd., *Merton Abbey, London, S.W.19*

This company will be exhibiting a comprehensive range of dial thermometers, recorders, and controllers. Bi-metal instruments will include a high-temperature thermometer specially-designed for Diesel engine use, also rigid stem thermometers with dial sizes from 1 in. to 7 in. in a wide variety of temperature ranges, presentations, stem lengths and diameters for most engine-room, marine, boiler-house, and associated purposes. Among mercury-in-steel thermometers, there will be distant-reading and rigid stem models; 4 in., 6 in., 8 in. and 10 in. dials, wall, panel or bracket mounting, edgewise-scale distant-reading patterns, and a number of patterns for special applications. There will also be shown vapour pressure thermometers, mercury-in-steel temperature recorders, temperature controllers, pressure recorders and pressure, vacuum, altitude and hydraulic gauges.

The British Steam Specialties Limited, *Fleet Street, Leicester*

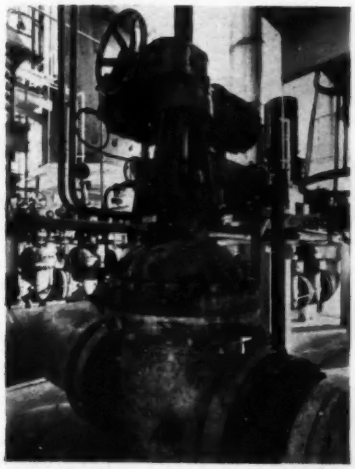
A range of Newman-Velan forged carbon-steel, chrome-molybdenum and stainless-steel bonnetless globe-valves will be exhibited by this company, together with a range of Newman-Velan wedge-gate valves. In addition a comprehensive range of gunmetal and cast-iron, flanged and screwed valves, Bowdon-type pressure gauges, bimetallic strip-actuated thermometers will be displayed. A full range of Velan steam-traps, for all pressures up to 2,500 lb./sq. in., and temperatures up to 1,100 deg. F. will be shown, these will include the Velan Monofloat steam-trap which is designed for discharging condensate at steam temperature. For use with high and low-pressure saturated and superheated steam, and also high-pressure hot water, a range of Vee-Reg globe-valves in bronze and steel will be on display. These are supplied screwed and flanged, and are fitted with V-ported stainless-steel clack and seat. Other exhibits on this stand will include single and dual filters, Rowepinch valves, and Boss-Robbe pressed-steel panel and column radiators for hot water heating systems.

Clarke, Chapman & Co. Ltd., *Victoria Works, Gateshead, 8, Co. Durham*

This firm, who are, of course, well known as manufacturers of a wide range of heavy engineering equipment including boiler plant for both central power stations and industrial installations, will be exhibiting representative examples of their products. Among the exhibits will be three new winches which will be full size exhibits and will comprise a fully-automatic constant-tensioning mooring winch, a three-speed a.c. cargo winch, and a hydraulic cargo winch. Other new exhibits will include a full size 128 b.h.p. reversing steam turbine, identical to those supplied for driving mooring winches on large tankers; a Golar vent turbo fan rapid gas-freeing unit manufactured by Clarke, Chapman & Co. Ltd. and Davidson & Co. Ltd., for F. A. Hughes & Co. Ltd., London (sole European licensees) will also be shown. This incorporates a Clarke Chapman uni-directional steam turbine. A working model of the "Algonquin" loader/unloader will also be exhibited, and will demonstrate this new method of handling of bulk cargo.

Clayton Dewandre Co. Ltd., *P.O. Box No. 9, Titanic Works, Lincoln*

Clayton Dewandre Co. Ltd. will be exhibiting their exclusive heat-exchanger, the "Clayton-Still" tube, and illustrating a few of the applications from the wide current range. This tube is of exceptional character; the extended surface of the tube consists of a continuous wire wound into elongated loops which are firmly bonded to the basic tube in a helical formation. As the rate of heat-transfer to or from a small-diameter wire is extremely high, the resultant large dissipating-surface, aided by air turbulence induced by the formation of the wire, gives a very high co-efficient of heat transfer. Wound tubes, with basic tube dia. of ½ in. to 3-in. and over-wire dia. of ¾-in. to 4½-in. can be supplied in up to 25 ft. lengths. Materials may be copper, copper alloys, brass, mild-steel, stainless-steel, etc. If the basic tube is of annealed copper or copper alloy, the finished wound tube can be bent to almost any desired shape. General methods of bonding the wire formation to the basic tube are by soft-soldering or, where higher temperatures have to be dealt with, by induction brazing, using a range of copper-silver brazing alloys. The latest form of bonding, used with iron wire and steel tube, is by hot-dip galvanising. This also provides corrosion protection. If required, the bore of the tube can be left free of zinc. Two special types of tube have been evolved for the cooling of oils and other hydrocarbon liquids. In both cases the inner surface (as well as the outer, if required) is extended: in one case by the insertion of three small-diameter tubes (usually only by the bonding-in of a spiral looped wire formation. This latter is now available without a centre rod so that it can be used in applications where the rate of heat exchange and the fluid pressure-drop are critical. Also on view at this stand will be a selection of the high-quality aluminium and alloy die-castings from the company's subsidiary, The Bridge Foundry Co. Ltd., Wednesbury, Staffordshire.



Motorised Flex-gate valve. (Crane Limited.)

Crane Limited, 15-16, *Red Lion Court, Fleet Street, London, E.C.4*

The main exhibits on the stand of Crane Limited, will include a working exhibit of a flex-gate 16-in. valve. This valve is a standard cast carbon steel unit with Crane patent flexible wedge disc. The valve is motorised for electrical remote control; a cast-steel flex-gate valve—a 4-in. valve with exellory (13 per cent. chromium) trim, cut to show the operation of the Crane flexible disc; a cast-steel wedge disc gate-valve with fluon seating—this valve being a recent development in valves designed for corrosive chemical lines where very tight shut-off is required. This type is, for example, especially suitable for handling chlorine gas. Also to be shown is a stainless-steel wedge disc gate-valve. In addition there will be representative examples from the Crane range of globe, gate and check valves, in bronze, iron, carbon and alloy steels, and also large steel valves for the power plant, petroleum, and chemical industries.

Consolidated Pneumatic Tool Co. Ltd., 232, *Dawes Road, S.W.6*

The main interest on the stand of the Consolidated Pneumatic Tool Co. Ltd. will be working demonstrations of a large number of tools from the firm's pneumatic, and high-frequency electric ranges, in addition to a static display which includes a number of new items. The demonstrations will include examples of work carried out by pneumatic and "Hicycle" impact wrenches, and the newly-introduced "3008 Magnamatic" screwdriver. A demonstration of drilling units will include airfed CP. 327 drills and such light production tools as the 3008, 3017 and 3075 pneumatic drills, in conjunction with "Hicycle" drills and tappers. Of particular interest will be a demonstration of the 495 "Hicycle" drill, mounted on a sliding radial arm. The static display on the stand will include two examples of the range of worm-gear jacks, in addition to a selection of riveting hammers, rivet cutters, chipping hammers, etc.

Copes Regulators Limited, 9, *Southampton Place, High Holborn, W.C.1*

Being featured on the stand of this company will be their B.I. marine feedwater regulator, high and low water alarms, pressure relay equipment, junior-type feedwater regulator which is in great demand for the increasing and popular ranges of packaged-type boilers and their latest development of the variable-orifice desuperheater which consists of a chamber containing a weighted ball, held over an orifice in the steam-main, at a point where the steam flows vertically upwards. This ball, which is the only moving part, is lifted by a pressure of about 3 lb./sq. in. to correspond to the rate of steam flow. The pressure-drop through the orifice, and with it, the steam velocity at that point remains constant for all rates of flow in the steam main. Cooling water at an excess pressure which can be as low as 30 lb./sq. in., enters a trough surrounding the orifice where it meets steam travelling at its highest velocity which causes extreme turbulence, thus breaking up the water into minute particles which readily vapourise. It has been found in practice that the Copes' variable-orifice desuperheater gives good control from 100 per cent. down to 2 per cent. full load, and holds final steam temperature to within plus or minus 5 deg. F. of the required setting even when this is as low as 10 deg. F. above saturated temperature. Mixing is said to be so rapid, that dry superheated steam at the correct temperature is produced only 20 ft. down stream of the desuperheaters, with a resultant reduction in time lag between variations in temperature and their correction. The flow of cooling water is regulated by a conventional diaphragm valve which reacts to air signals transmitted from a temperature-controller fitted a short distance down stream of the desuperheater.

The Darlington Chemicals Group of Companies, *Darlington, Co. Durham*

The three companies in the Darlington Chemicals Group who will be exhibiting, are—The Chemical & Insulating Co. Ltd., The Darlington Insulation Co. Ltd., and Darchem Engineering Limited. The first mentioned company produces magnesia chemicals and a wide range of thermal insulation materials. A sculptural display of pipework insulated with 85 per cent. Super-Magnesia, Paratemp and Dextramite will be featured. Examples of Refrasil, a pure silica fibre, will be shown in various forms. It is capable of withstanding continuous high temperatures up to 1,000 deg. C., and has outstanding thermal and electrical insulating characteristics. Darlington Insulation Co. Ltd. are well-known as insulation engineers and contractors for heat, cold, sound and structural insulation. Photographs will depict the application of insulating materials on power station plant, and for marine and chemical installations. Specially-developed insulation coverings and finishes will also be shown, while an illuminated map will show the nuclear power station sites where the company is currently doing insulation work. Darchem Engineering Limited are precision fabricators of metals, with experience in the field of specialised welding techniques on light-gauge steel. Their stand will feature marine-type insulation blanket, which is a section of the marine version of a stainless-steel covered Refrasil blanket used on gas-turbines; examples of specialised welding work in a range of metal gauges including stainless-steel and inconel, from 0.002 to 0.25 in.; the Rostenit lining process, and stress-relieving blankets which are used in a process providing an *in-situ* service for stress-relieving of welded pipes.

Drysdale & Co. Ltd., *Bon-Accord Works, Yoker, Glasgow, W.4*

The Drysdale stand will feature a selection of pumps for land and marine services, and will include two new designs of which both are positive rotary gear wheel pumps. The first pump, known as the "Axoil" pump is for marine forced-lubrication and piston cooling, and is made in a range of five sizes to cover outputs from 11.5 to 165 tons/hr. The second pump to be shown is for furnace fuel-oil pressure feeding, and is known as the "Vertoil" Mark II, and a range of six sizes cover outputs between 560 lb./hr. to 66,000 lb./hr., with working pressures up to 600 lb./sq. in. Oils with viscosities up to 6,000 secs. Redwood No. 1 can be handled. The "Vertoil" Mark II is also of the vertical mid-mounted type, the pump being suspended from the underside of the motor stool. The rotors are of the spur gear type to enable high pressures to be obtained with hot thin oil. The electric driving motors can be supplied to suit 50 or 60 c/s.

The English Electric Co. Ltd., *London, W.C.2*

Among the English Electric exhibits will be examples of various gas-turbines, including a model of the EM27P industrial unit, one of three ordered by the Assam Oil Company for the Nahorkatiya power station, to supply power for the oil refinery. Two sets, to run on natural gas, are now erected. The EM27 is designed to operate on distillate fuels, natural gas or crude oil. It is a compact, open-cycle, two-shaft unit, readily transportable and easy to install for many industrial, traction and marine applications. The marine exhibits of Switchgear Division, Liverpool, will emphasise the growing use of a.c. in ships. The atomic power plant display will mainly concern Britain's latest nuclear power station, which is to be built at Sizewell, Suffolk, by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group. It will be backed by a photographic display of Marconi Instruments' work in nuclear instrumentation, covering health and safety instrumentation, data handling, neutron flux measurement, gamma ray monitoring and burst slug detection.

English Steel Corporation Limited, *River Don Works, Sheffield 9*

The Darlington Forge Limited, Darlington (a wholly-owned subsidiary company of English Steel Corporation

Kellogg's choose

—FOR A VARIETY OF

ISSUED BY THE NATIONAL COAL BOARD

COAL

GOOD REASONS

Hot sunshine and golden grain, harvested at the peak of perfection—that's Kellogg's, the name that has brightened the breakfast tables in scores of millions of homes on both sides of the Atlantic.

The men who have so successfully changed the staid eating habits of nations are demonstrably men of both vision and sound judgment—two qualities which guide and control every long-term decision they make. Take fuel, for example. When the choice of fuels was examined, Kellogg's voted for coal. Why? Because—among many other good reasons—they knew that coal provides all the steam power they need at the lowest cost; because coal—mechanically stoked—is smokeless; and because British coalfields can supply all the coal that industry will need both now and in the foreseeable future.

When the time comes for you to make a decision on fuel, remember Kellogg's. Coal has helped them to create a mouth-watering success. It could well heap your own plate with the same golden sunshine.

PROGRESSIVE INDUSTRY IS GOING FORWARD ON

COAL

Coal into energy at Kellogg's Stretford Factory

Mr. E. Tomlinson, Plant Engineer, comments:

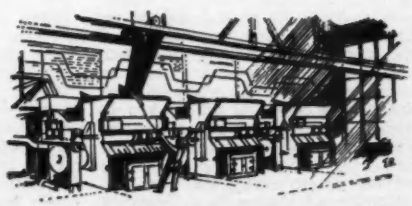
"Our processing plant operates continuously every week from Sunday night until Saturday morning, with an average load of 45,000 lbs. an hour, and intermittent peaks of up to 50,000 lbs. an hour. We have three water tube boilers, all operating on coal. Normal operation is with the largest boiler, fitted with an economiser, which maintains an efficiency of 83%, and one small boiler, without economiser, with an efficiency of 71%. The other small boiler is maintained as a stand-by; this is completely filled with treated water to prohibit corrosion and is available for immediate firing.

The original installation at Stretford was completed in 1937 when two water tube boilers were installed, both fired by chain grate stokers. Each boiler was designed to generate 17,000 lbs. of steam per hour, which was sufficient for operation of the plant.

In 1946 began a period of expansion and very soon both boilers were steaming continuously to provide sufficient steam for processing the growing output of various breakfast cereals. In 1950 a further water tube boiler was installed and, guided by the trouble-free service of the other two boilers, this unit was also fitted with a chain grate stoker for coal firing. Anticipating the Clean Air Act, we arranged to have grit arresters fitted to the new boiler and the two original boilers. Such was the growing demand for steam that the largest boiler was supplying steam to process before the official commissioning trials had taken place. This boiler was rated at 40,000 lbs. per hour and has been in continuous operation ever since, being shut down only for our annual holiday period when it is thoroughly cleaned and inspected.

We expanded again in 1954 and when further modernisation plans were considered we found that the two original boilers could be rebuilt to meet modern demands. Today all three boilers continue to give us a first-class service.

Our decision to burn coal is based on the extreme reliability of the coal handling and firing equipment, together with the economic fuel cost."



Here are some key facts and figures about the consumption of coal at Kellogg's:

Boilers:	3 water tube
Method of firing:	chain grate stokers
Boiler efficiency:	80%
Max. steam rating:	74,000 lbs/hr
Steam pressure:	165 p.s.i.
Steam temperature:	375°F
Annual fuel consumption:	13,500 tons of coal

Limited, Sheffield) will feature exhibits concerning the company's products for the nuclear energy industry. The main feature of display will be a 5-ton forged-steel gas-duct reinforcement ring. This ring, from which a test portion will be cut away to reveal the cross section, will be of a similar type to several that have already been supplied by The Darlington Forge Limited, for use at Bradwell Nuclear Power Station. Other products, such as forged-steel shaft brackets, tail-shafts, backposts, rudderstocks and cast-steel Sternframes for the marine industry, hoppers and bells for blast-furnaces and cast-steel rolling mill housings, will be featured pictorially.

Film Cooling Towers (1925) Limited, *Parkshot, Richmond, Surrey*

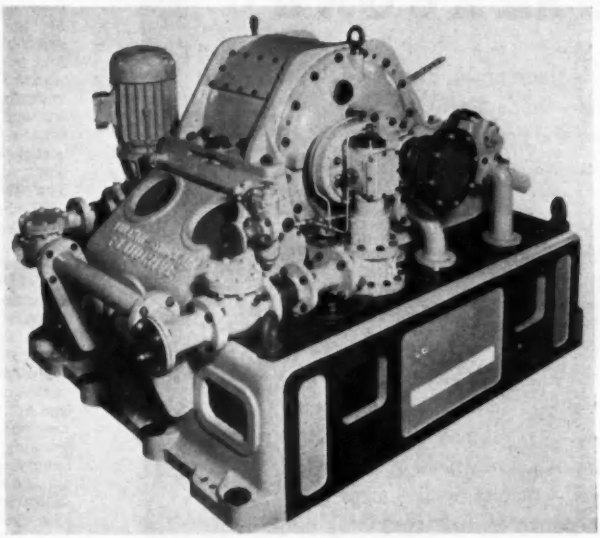
A specimen "Packaged" water cooler with resin-bonded glass-fibre laminate shell, will be the main exhibit on this stand. The cooler, which will be in operation, is one of a range developed for particular appeal in refrigeration and engine cooling or similar duties. The display will include full-scale examples of coloured cement asbestos sheeting, also timber cladding as employed in forced- and induced-draught towers. A scale model of a twin-cell induced-draught concrete-shell cooling tower will be on show, and literature and information will be available on the whole range of the company's designs—from giant hyperbolic concrete natural-draught towers to plastic-packed mechanical-draught industrial towers.

Thos. Firth & John Brown Limited, *P.O. Box 114, Atlas Works, Sheffield 4*

As alloy-steel makers, forgemasters, heavy engineers and steel founders, Firth Brown will be illustrating a representative range of all their products. These will include carbon and alloy-steel forgings for marine turbines and transmission gears and power generation, forged-steel cylinders, rings and other forgings for gas-turbine and jet-propulsion units, and forged-steel die blocks. This firm's forged-steel rolls for the rolling of ferrous and non-ferrous sheet and strip, precious metals, plastic, etc., are supplied in the fully-hardened condition up to 36-in. dia., 17½ tons in weight and back-up rolls up to 56-in. dia. and 45 tons in weight. Rolled-steel products are available in the form of black and bright bars for highly-stressed parts in the general engineering industries. The company also specialises in the manufacture of high-grade steel castings for heavy-duty wear, for use in industry generally. The whole of these manufacturing resources are backed by extensive research facilities and these will adequately be illustrated.

Fluidrive Engineering Co. Ltd., *Fluidrive Works, Worton Road, Isleworth, Middx.*

The several different types of Vulcan-Sinclair fluid coupling cover a wide range of powers and duties, from 1/10 h.p. to 10,000 h.p. and more, and examples of most of the main types will be exhibited. In the higher power range a size 22½ double-circuit scoop-trim variable-speed fluid coupling, type DST, will be shown, being one of 10 sets rated at 5,200 h.p. at 3,600 r.p.m., for driving boiler feed pumps at the Lakeview Power Station in Canada, and as supplied for driving 4,000 h.p. CO_2 gas-circulators for nuclear power plants. The rotating parts of a size 24½ DST will also be exhibited, these being part of a dozen such fluid couplings for British power stations, the top rating for this size being 8,000 h.p. at 3,000 r.p.m. Sectional models of standard traction, step-circuit and Fluidrive pulleys will be exhibited, as well as a sectional model of a size 18 scoop-control fluid coupling, type SCR4, giving a maximum variable regulation of 5 : 1. Working models will be available to demonstrate the characteristics of the different types of fluid coupling. An entirely new working model will be exhibited for the first time, the purpose of which is to demonstrate the two main methods of controlling the output of a centrifugal pump, namely, by varying the speed with a fluid coupling and, alternatively, by a regulating valve. The 8 h.p., 2,970 r.p.m. S.C. motor will drive a Hayward-Tyler pump by means of a scoop-control fluid coupling and the comparative performance between the two regulating systems will be shown by instruments, including flow meter, pressure gauge, wattmeter and tachometer. This working model should be of interest to engineers concerned with power generation, the oil industry, chemicals, plastics, pulp and paper mills, to mention but a few of the industries in which the application of Fluidrive for flow control is increasingly being used.



Type D.S.T. double-circuit, scoop - trim fluid coupling. (Fluidrive Engineering Co. Ltd.)

Fraser & Fraser Limited, *Bromley-by-Bow, E.3*

This company will be exhibiting a Fraser patent radiant-heat water-tube boiler of the mild-steel welded sectional-type. It will be in sectional form, showing the salient features of design and construction. This type of boiler is completely water-jacketed, the large water-walled furnace is claimed to ensure perfect combustion of solid or liquid fuels, thus making full use of radiant heat. Straight water-tubes, inclined at a steep angle promote rapid unidirectional circulation, and give freedom from scale deposit, resulting in high heat-transfer rates. A water-cooled baffle, forming the rear-wall of the furnace with the riser tubes, ensures definite circulation; provides two gas-passes which make full use of convected heat-transfer from the low-temperature gases through the second-pass, resulting in high efficiencies of the order of 80 per cent. Access doors are provided to allow for easy tube-cleaning. Details and models of other types of water-tube boilers, pressure-vessels, tanks, chimneys, flues, buoys, fabricated platework will also be featured.

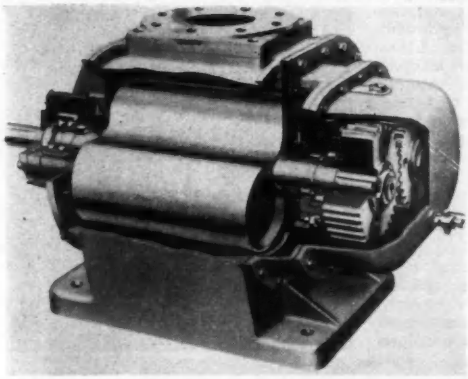
Gwynnes Pumps Limited, 62-64, *Chancellors Road, Hammersmith, London, W.6*

This company will have as their main exhibits large pumps for power stations, and sewage pumps. The cooling-water circulating pump to be shown in one of a batch of six with 33 in. discharge and suction branches; each is designed for a capacity of 30,000 g.p.m. against a total head of 55½ ft., when running at 590 r.p.m., driven by a 620 h.p. motor. The casing is of cast-iron, impeller of stainless-steel, mechanical seals are fitted. The popular split casing pump of sizes 2 in.-8 in. will be shown re-designed with mechanical seals and self-aligning ball bearings; likewise, a single-inlet pump also incorporates mechanical seals and dual ball bearings as a standard feature.

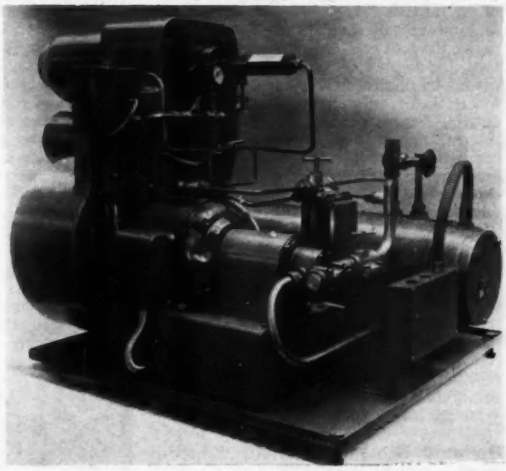
G. A. Harvey & Co. (London) Ltd., *Greenwich Metal Works, London, S.E.7*

This company will have as their principal exhibit, a 20-ton jacketed autoclave, which will be used in the manufacture of industrial chemicals by a high-pressure hydrogenation process.

Two have already been completed and delivered. The autoclave shell is made of 1½ in. stainless clad steel, the cladding being to F.M.B. Specification. It is 6 ft. inside diameter, 11 ft. high and has been made to Class I requirements and is fully stress-relieved. The dished and flanged ends were spun in the company's works on the rotapress machine. On completion, the shell was hydraulically tested to 825 lb./sq. in. A multi-bladed impeller driven by a 50 h.p. motor mixes the autoclave contents at 120 r.p.m. under a working pressure of 500 lb./sq. in. and temperatures up to 200 deg. C. A "Flexibox" mechanical seal is fitted at the top of the autoclave where the impeller spindle enters. Also shown on this stand will be two scale models. One is a part-sectioned model of a fractionating column as used in the oil refining industry and typical of many supplied by Harveys. The other is of the Rolls-Royce jet engine test plant, for which Harveys were responsible for the design, fabrication and erection of test cells, pressure vessels and ducting.



(Left). Type "RBS" Holmes-Connersville positive air-blower. (W. C. Holmes & Co. Ltd.)



(Right). Typical Riley oil-burner. [Riley (IC) Products Limited.]

W. C. Holmes & Co. Ltd., *Turnbridge, Huddersfield*

Holmes-Kemp inert-gas generators, which will be featured on this stand, are designed to produce an inert gas to any desired specification by the controlled combustion of fuel gas or fuel oil. They can be arranged to produce either continuously or intermittently. Also to be shown, are the Holmes-Kemp dryer and the Holmes-Connersville positive air-blowers. A section of the stand will be devoted to Holmes-Elex electrical precipitators which have been specifically designed for the removal of extremely small particles (in the sub-micron range) from all types of carrier gas. The particles, either liquid or solid, are separated by passing the contaminated gas through a high-voltage electrical discharge which imparts a negative charge to the particles, and then deposits them on to collecting plates. The Holmes-Schneible multi-wash system will also be shown.

James Howden & Co. Ltd., 195, *Scotland Street, Glasgow, C.5*

James Howden & Co. Ltd., will, in addition to typical fan equipment exhibits, feature Howden-Lurgi electro-precipitators which are available for a wide range of applications, including the cleaning of gases from power station boilers, blast-furnaces, sinter plants, open-hearth furnaces and convertors, cement-making processes and such-like. The precipitator designs are based on many years of practical experience in these fields, and provide high extraction efficiencies allied with low power consumption and low pressure-drop. The detailed designs differ according to the application, and the specified performance and include parallel plate arrangements, incorporating one, two or more precipitator zones in series (as required), for horizontal or vertical gas-flows, and vertical-tubular units, with centrally-disposed wire or other suitable discharge electrodes in each case. Casings are of fabricated mild-steel construction, suitably lagged and weather-protected where necessary, or may be of reinforced-concrete. The former allows for considerably reduced foundation loads.

Hunt and Mitton Limited, *P.O. Box 144, Oozell's Street North, Birmingham* 1

The emphasis on Hunt and Mitton's stand will be on the equipment which they provide for automation. There are two fieldse specially catered for;—(a) automatic control of heavy hydraulic machinery, accumulators, etc. Such controls are in use in many countries of the world. (b) Automatic process control valves with either linear, logarithmic, or on/off characteristics. The automatically-operated valves for hydraulic machinery are pneumatically-operated through an integral diaphragm actuator. The pneumatic signal may be controlled either manually, electrically, or mechanically. The process control valves have a wide application on steam, liquids and gases, in chemical process plants, in the pharmaceutical industry, in paper-making and textile manufacture, in gas-producing plants and, indeed, increasingly over the whole range of British industry. These valves are suitable for use with instruments of any of the standard manufacturers.

International Combustion Limited, *Nineteen Woburn Place, London, W.C.*1

The combined exhibits of the International Combustion Group of Companies display on this stand will feature particularly new developments and the manufacturing ability of the organisation. The central boiler exhibit will be a new sectioned scale-model of the International Combustion 550-MW boiler unit for Thorpe Marsh power station. This unit will be allied to a display featuring recent great advances in the boiler design techniques both at home and abroad, to which the company has contributed. New International Combustion developments to be featured include the introduction of the Raymond Flash Drying System, new sizes of Vacseal pumps, the Dynoscreen centrifuge and new screening equipment. Riley (IC) Products Limited are exhibiting a small chain-grate stoker based on the proved type "T" stoker, widely installed throughout industry, the Robot underfeed stoker and the recently-introduced Riley-Pillatt industrial incinerator. The stand will include a display featuring recent advances in oil-burner development and this will be coupled with a display of control equipment covering a wide range of operation. The whole theme of this stand will be engineering progress, and this will be substantiated by the choice of recently-developed equipment as the many exhibits.

Ivor Power Speciality Co. Ltd., 29, *Woburn Place, W.C.*1

Sootblowing equipment for cleaning shell-type and water-tube boilers will be exhibited by this company and will comprise:—the Ivor traversing-jet sootblower, mainly used for vertical, economic, and smoke-tube boilers and operated by means of chain or extended hand-operating gear; the Ivor industrial gun-type sootblower which is suitable for cleaning the walls of screen tubes of water-tube boilers; the electrically-operated valve-in-head gun-type sootblower for cleaning combustion-chamber walls and connection tubes; a small retractable chain-operated lance-blower, and sootblowers operated by compressed-air, using a radial piston-operated motor, of particular application to overseas and marine installations.

Keith Blackman Limited, *Mill Mead Road, N.17*

A selection of fan equipment in general, and marine fan equipment in particular, will be seen on this stand. They will include a 23-in. marine-type axial fan with d.c. totally-enclosed motor and eight-bladed adjustable-pitch impeller. The fan casing has twin watertight access-doors adjacent to the motor, to facilitate servicing when necessary. Many fans of this type are in service for engine and boiler room mechanical draught. Also being shown is a 19-in. AFX fan with indirect-drive motor, mounted external to the casing, and driving through V-ropes. This arrangement is claimed to give excellent accessibility to the motor, and isolates it from the air stream which may be contaminated. A selection of fans from the wide range of equipment always available from stock is represented by an APA-type propeller fan and an 'Aristocrat' centrifugal fan. A display illustrating the working principle of the "Tornado" bifurcated fan is shown by a 10-in. fan constructed entirely from clear p.v.c. A light material representing fumes and contaminated air is handled by the fan, and the bifurcating or splitting of the duct round the motor compartment is clearly visible. A working model of the Type-PS elevator will be on show, demonstrating the pneumatic siphon system for elevating granular materials in a fluidised state. The company's industrial-gas display will include equipment for high and low-pressure gas, burner nozzles and burner heads, injectors, the Type-3 zero governor, Type-3 mixture-controller and a direct-driven rotary compressor for air and gas up to 5 lb./sq. in.

Richard Klinger Limited, *Klingerit Works, Sidcup, Kent*

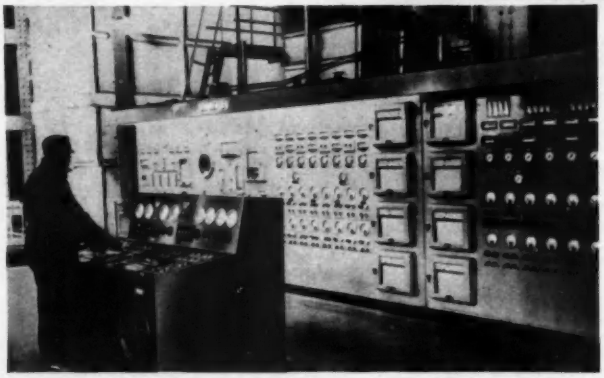
This firm will feature exhibits from their comprehensive range of equipment for fluid control and handling. The exhibits will include Klingerit—the universal jointing; Klinger-Oilit—designed to give maximum resistance to all types of oils and solvents; Klingerit 1000—wire-reinforced jointing for the most extreme conditions; and Klinger-Acidit—designed to resist extreme acid conditions. The Klinger synthetic materials to be exhibited will include Klinger-Silon—a silicone rubber having outstanding thermal stability; Klinger-Lastic—which is specially compounded to provide maximum resistance to hydrocarbons, oils and solvents; and Klingerflon thread steel—a new thread sealant for all pipe fittings. It is also available in the form of string which is particularly suitable for heavy engineering application. Other exhibits will feature Klinger spherical plug-cocks, and sleeve-packed cocks, and also Klinger liquid-level indicators, and seatless piston valves.

Lee, Howl & Co. Ltd., *Tipton Engineering Works, Tipton, Staffs.*

One of the principal exhibits on the stand of this company will be their 3-in./4-in. multi-stage, split-casing, high-speed turbine pump suitable for outputs of 17,000 g.p.h. against a head of 2,000-ft. This is a modified design from the original range, and achieves 2,900 r.p.m. It was produced to meet the demand for higher pressure duties in mines drainage, boiler feeding and water supply. The number of pump stages has been kept small, but higher speeds have been achieved, which reduce the size and the cost of the pumps. A particular feature of this modified equipment is that it is designed for centre-line suspension—that is, the feet are at a level near the centre of the pump instead of underneath the pump. As a consequence, moderately high temperatures up to 400 deg. F. can be handled, because any expansion by heat does not take place from the feet upwards but symmetrically from the centre (up and down) without affecting the height of the pump coupling. Other features illustrate the high efficiency over a wide range of head and capacity that can be maintained. Robust construction is attained by the casting of the volutes and axial passages integral with each half of the casing. The walls of these chambers strengthen the casing and prevent any tendency for distortion under high pressure. Accessibility is facilitated with the split casing and smooth running is assured due to hydraulic balance.

Lockheed Precision Products Limited, *Speke, Liverpool*

In this modern age of mechanical-handling and automation, the remote control of equipment has rapidly developed from the stage of a luxury or convenience, to that of an absolute essential. During many years of pioneering in high-precision hydraulics, Lockheed have acquired unequalled experience. They have supplied equipment for power stations, waterworks, marine engineering, atomic energy plants, steel works, refineries and many more diverse installations all over the world. On their stand at the exhibition, a representative selection of Lockheed industrial hydraulic units will be exhibited. This will be in the form of a series of special displays illustrating selected Lockheed installations throughout the British Isles. Examples of Lockheed control valves, relief valves, semi-rotary slave valves, jacks, hydraulic motors, etc., will all be seen in their high quality production finish. Also displayed, will be examples from the wide range of Lockheed-Avery hoses and self-sealing couplings. Low, medium and high-pressure hoses will be shown, the latter capable of carrying pressures up to 5,000 lb./sq. in. in sizes ranging from ¼ in.-2 in. bore. Examples of quick release self-sealing couplings, and the wide range of re-usable end fittings, a special Lockheed-Avery feature, will also be displayed.



(Left). Centralised hydraulic control console installed in Barony Generating station. (Lockheed Precision Products Limited.)

Metallisation Limited, *Barclays Bank Chambers, Dudley, Worcs.*

Metallisation Limited will demonstrate a new method of hardfacing, viz.:—the Sprayflow Stellite hardfacing process. The practice of hardfacing with Stellite is well-known, and the conventional techniques of application by gas and arc-welding provide perfectly satisfactory hardfacing deposits of over $\frac{1}{16}$ in. thickness. When it is necessary to apply thinner coatings, the results may not be as satisfactory, owing to dilution of the overlay by the parent metal. Furthermore, components of thin wall section often suffer severe distortion when subjected to the welding processes. For this reason, extensive research was carried out to develop a suitable application process for materials having equivalent properties. The outcome of this research was the introduction to the range of Stellite alloys in rod form which can be readily applied by the Metallisation Mark 33 metal-spraying pistols. The deposits so applied exhibit the typical structure of sprayed metals, but by means of a subsequent fusing operation they are converted to a homogeneous overlay metallurgically bonded

(Above). Metallisation Mark 33 metal-spraying pistol. (Metallisation Limited.)

to the parent metal. Deposits produced in this way have little variation in thickness and thus demand the minimum consumption of materials and grinding time for finishing.

Murex Welding Processes Limited, *Waltham Cross, Herts.*

The display on the stand of Murex Welding Processes Limited will mainly emphasise the use of automatic welding and will include a typical welding installation for general and Class 1 work and a working demonstration of the versatile "Muramatic" automatic welding head. The company will also be showing new and improved versions of existing manual metal-arc welding electrodes. In spite of the increased applications of automatic welding most of the welded construction at present being carried out is welded with manual electrodes and the Murex Research Laboratories are making a major contribution to the welding industry in the continued development of new and improved types. Murex electrodes have recently been used on many important projects at home and abroad such as the Windscale AGR, the new Shell building, the passenger liner *Oriana*, the new Forth Bridge, the Italian nuclear power station at Latina and the *Dreadnought*, Britain's first nuclear submarine. The Murex "Muramatic" welding head has been designed for use with either the submerged-arc or open-arc process using either a.c. or d.c. supply, and with welding currents of up to 1,200 A. The welding head can be mounted in many different ways and it can be used in the form of a single- or double-headed deckwelder or mounted on booms, columns, mobile platforms, etc. Murex Welding Processes Limited supply a comprehensive range of welding equipments including transformers, motor generators, rectifiers, petrol and Diesel engine-driven generators, etc. All the Murex rotary equipments incorporate the unique "Dynex" or type 3000 welding generators which provide a stepless current adjustment over the complete power range.

Newalls Insulation Co. Ltd., *Washington, Co. Durham*

A new development displayed by Newalls will be a range of rigid polyurethane pipe sections. This very light material has high structural strength and a very low thermal conductivity and is suitable for all types of low-temperature piping application. Erection is very rapid by conventional mechanical methods or adhesion, and most of the usual finishing materials can be used. Newalls are now engaged on contracts using polyurethane foams which may be foam dispensed, or poured as a liquid-mix into cavities of complex design or difficult of access. The liquid, expanding as it foams, follows the contour of the cavity walls, ensuring an intimate contact and good adhesion between the insulant and the shell. Also being exhibited are the full range of Newalls well-known products for all forms of thermal and sound insulation necessary in shipbuilding and marine engineering. These materials include the long established Newalls registered brand products such as 85 per cent. Magnesia, Asbestos and Newtempheit, which are applied in varying extents on the nuclear plants at Chapelcross, Berkeley, Bradwell, Dounreay, Hinkley Point, and Winfrith Heath. A full range of Newalls Newtherm calcium silicate insulation products will also be shown. This material, in addition to extensive use for power stations and marine work, has been specified and used for numerous large oil refineries.

Newman, Hender Group of Companies, *Woodchester, Stroud, Gloucester*

In addition to displaying a wide range of their standard valves and associated fittings, the Newman Hender Group of Companies will feature several new developments, among which, is a new range of valves, said to be unique in this country, which can be fully serviced and tested under pressure while still connected to the pipeline. Known as the Newman-Velan range, and which are now being made under licence from Canada, are forged-steel, bonnetless gate or globe-types which are available in a range of sizes up to 2-in. Both types have "inline" servicing as their main feature. The gate type has been designed for working pressures up to 600 lb./sq. in. at 800 deg. F., (2,000 lb./sq. in. cold, non-shock), whilst the globe type is primarily intended for high pressure/high temperature service, and by design and interchangeability of parts, can be supplied as stop, stop-check or needle-valve. Another range now being manufactured by the Group is the "Newman-Seaman Snap" air/gas valve. This is a push-button controlled valve, for working pressures up to 200 lb./sq. in., giving a positive and instantaneous on/off control for air and gas lines. As there is no handwheel, spindle, gland or stuffing box the valves are remarkably compact, simple in construction and require little maintenance. They are available in sizes from ¾-in. to 1-in. and there are two types; one for normal duty and another suitable for pressurising and exhausting cylinders. Newman, Hender are also now fitting polytetrafluo-roethylene sealing faces to certain of their ranges. This material is hard wearing, chemically inert and has a low co-efficient of friction and is thus ideal for the working surfaces of wedge- or gate-type valves. Newman-McEvoy large, automatic, self-sealing gate-valves, which have been in production for some time as high-quality, high-pressure units are now available as well in an ultra-compact and cheaper cast-iron version for lower-pressure duty.

Pantak Limited, *Vale Road, Windsor, Berks.*

This company will be exhibiting their full range of Balteau portable industrial X-ray units in addition to details of the range of mobile equipment which they produce. Also on show will be a selection of radiographs, taken by equipment ranging from a small lightweight gas-filled unit of 150-kV capacity to a mobile industrial betatron of 18 MeV. The portable Balteau range consists of two oil-insulated units of 140 kV and 200 kV capacity, and two gas-insulated units of 150 kV and 300 kV capacity, both the 150 kV and 300 kV units being produced in special forms for 360° beam radiography as required, for example, in pipeline examination. Pantak's mobile range of oil-insulated units comprises models of 150-kV, 300-kV and 400-kVp capacity, a large number of these units being employed in the pressure-vessel fabrication industry. The 400 kVp machine is claimed to be the largest of its kind produced in the U.K. The Siemens 18 MeV betatron which the company market in the U.K. has been developed for mobile use in the examination of steel thickness greater than 4 in. One of the particular features of this unit is the use which may be made of a "hot state" radiographic technique which eliminates the need for alternate cooling and heating of the work-piece and thus eliminates the danger period when flaws may develop. A further feature is the use of an enlargement technique with this unit in which the most minute flaws, beyond the range of any other X-ray unit or accelerator, are readily detectable.

The Pyrene Co. Ltd., *Metal Finishing Division, Great West Road, Brentford, Middx.*

The theme of the stand of the Metal Finishing Division of this company will show how their Bonderising and Parkerising phosphating processes can be applied at the initial manufacturing stages of steel parts, and in their final finishing treatments. Part of the exhibit will be devoted to the use of Bonderising in the cold forming field, i.e., for assisting wire drawing and tube drawing and the use of Bonderising/Bonderlube for aiding the deep drawing and cold extrusion of steel. Photographs of typical plants and examples of formed parts will be displayed. The other section of the stand will be devoted to the use of Pyrene phosphate processes for finishing components and shown here will be: Bonderising as a base for paint, Parkerising as a rustproofing finish and Parco-Lubrising for wear resistance.

Reavell & Co. Ltd., *Ranelagh Works, Ipswich*

On the Reavell stand will be shown a representative selection of the company's smaller reciprocating and rotary compressors and exhausters for air and gases, of which over 150 different types and sizes are in current production, including air-cooled and water-cooled machines of modern design for pressures up to 4,500 lb./sq. in. Examples of carbon-ring reciprocating and carbon-blade rotary-compressors to deliver completely oil-free air or gases will be displayed, and two types of air-engines for starting internal combustion engines. Photographs of the company's larger machines will be on view, and full technical information concerning all types will be available, including reciprocating machines up to 8,000 cu. ft./min. capacity and turbo-compressors up to 40,000 cu. ft./min. capacity and 25 : 1 pressure ratio.

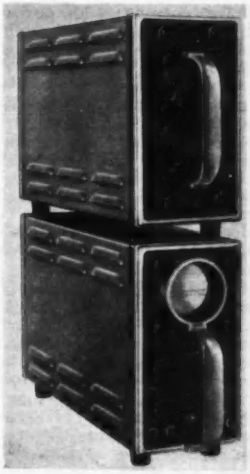
Richardsons, Westgarth & Co. Ltd., *Wallsend, Northumberland*

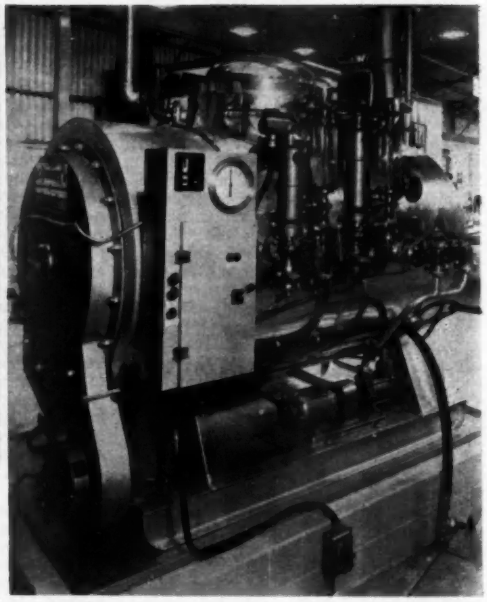
Exhibits which this company will be showing are split into two main categories:—land products, and marine products. Concerning the land products the Richardsons Westgarth Group are actively engaged in many aspects of engineering, particularly power generation. In association with Atomic Power Constructions Limited they are supplying the whole of the generating, condensing and feed-heating plants, as well as the CO_2 circulators for the Trawsfynydd nuclear power station in North Wales. Exhibits will include various products developed for Trawsfynydd, among others an entirely new type of bellows-restraint mechanism, a CO_2 blower-rotor and a scale model of a cascade corner-bend for the CO_2 circuit. A colour film, showing work in progress at Trawsfynydd nuclear power station, will also be shown, while a special display will be devoted to vacuum flash-evaporators, which the Richardsons Westgarth Group pioneered in Great Britain. This will include an animated flow-chart of a typical Richardsons Westgarth evaporator. Dealing with the group's products for marine applications, photographs and models showing some of the different types of engines produced by the Marine Division will be shown and will include a model of a Götaverken engine, a model of the engine room of the m.v. *Turakina*, showing a Clark-Sulzer 8RD76 engine fitted with exhaust-gas turbo-blowers, and a model of the machinery section of a 40,000 ton d.w. tanker with Parsons' marine geared-turbine propelling machinery and Richardsons Westgarth-Foster Wheeler water-tube boilers.

Ruston & Hornsby Limited, *Lincoln*

New types of engines from the large range of diesel units suitable for marine propulsion or auxiliary duties will be among the exhibits on the stand of the Ruston Group, which comprises Ruston and Hornsby Limited, and the associate company Davey Paxman & Co. Ltd. The largest unit will be a five-cylinder propulsion engine from the AT series, Ruston's latest range of large, medium-speed industrial and marine diesels. An entirely new exhibit will be the turbo-charged 6 YEXM unit which has been developed from the well-known YE diesel range. This is a four-cycle, direct-injection type engine, having six cylinders. Another new exhibit with marine-auxiliary as well as industrial application is the two-cylinder YWAH air-compressor set, which is a Ruston two-cylinder 2YWA engine with one cylinder replaced by a Hamworthy air-cooled single-stage air-compressor. There will also be exhibited a 30 in. Ruston-Grayloc pipe connection, designed for use where liquids and gases at high pressures and temperatures are involved. Made in a range to suit standard pipe sizes of from 1 to 30 in., these connections employ techniques different from any other seal, being both lighter and smaller than conventional bolted flanged connections for a given duty.

Three engines will be displayed from the Paxman range. From the 230-610 b.h.p. air-cooled range there will be an 8YGAXM 320 s.h.p. unit fitter with a reverse/reduction gearbox of the Self-Changing Gear Company's manufacture. Representing large engines made for traction purposes, will be a 12YJCL vee-form 12-cylinder intercooled pressure-charged unit having a continuous rating of 1,500 b.h.p. at 1,400 r.p.m.





(Above). Mark 5F Ultrasonic flaw detector and two-channel flaw alarm. (Smiths Industrial Division.)

Smiths Industrial Division, *Wembley, Middlesex*

Smiths Industrial Division will be represented on two stands at the exhibition; ultrasonic flaw-detection equipment will be exhibited on one stand and industrial instruments on the other. The Mark 6 ultrasonic flaw-detection equipment comprises a powerful and versatile instrument designed for routine inspection within production units, and for laboratory investigation into the transmission characteristics of materials. Special design features of the equipment include a wide operating frequency range, calibrated time base, delay and markers; stabilised power circuits and a 5 in. c.r.t. display. During the exhibition, the equipment will be demonstrated with a special rig for tube-testing in conjunction with the Kelvin Hughes two-channel flaw-alarm unit. Also on display will be the Mark SF, a multi-frequency instrument specially designed for production testing and for laboratory investigations where the applications involved can be adequately met by the use of probes having twin or common transmitter/receiver transducers. Other products to be exhibited on the second stand include: pressure and temperature gauges; magnetic and electric tachometers; electronic frequency meter; unit counters; rudder angle and d.c. r.p.m. indicators; combined bridge instrument panel; a marine engine instrument console, and a large instrument console provided for an important diesel engine application.

Spanner Boilers Limited, *Bracknell, Berkshire*

This company's exhibits will include one of their "Swirlyflo" marine composite boilers, and also a working model of the new "Swirlyflo" "Mark 3" boiler which is available in sizes having outputs ranging from 600 to 10,000 lb./hr., and is suitable for land and train-heating purposes as well as for marine applications. The new "Mark 3" boiler is of completely concentric design, that is, the furnace is concentric with the shell, thus almost entirely eliminating uneven stresses. The tube plates are vertical so that they do not collect mud and scale and thus give rise to overheating. The company's patent "Swirlyflo" tubes which are of helically-grooved design give a much higher heat-transfer rate than ordinary plain tubes, and are arranged on each side of the furnace leaving the top and bottom of the furnace clear so that it can be easily examined. The arrangement of the oil burner is such that the actual combustion elements can be easily removed from the boiler for cleaning and adjustment. While the horizontal boiler occupies no more floor space than the conventional vertical boiler (when the projection of the oil burner on the vertical boiler is taken into consideration) it is shorter in height and can be installed in rooms of low headroom. It has a relatively small water-content so that steam raising is very quickly achieved.

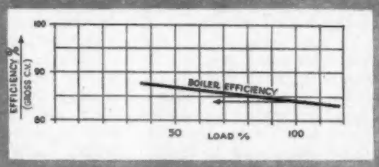
New "Swirlyflow" Mk. 3 Model 75G boiler. (Spanner Boilers Limited.)

Sterling-Safway, *Iddesleigh House, Caxton Street, London, S.W.1*

Sterling-Safway Unit Frame Scaffolding have developed a fabricated hoist tower which is claimed to be the first that has been produced in this country.

CENTRAX GUSTAVSBERGS

- ★ Suitable for the automatic firing of oil or solid fuel, and is readily convertible to either.
- ★ Modern, welded steel plate construction gives low first cost.
- ★ Ease of access for cleaning produces
  High Annual Efficiencies
  Low Maintenance Costs
- ★ Controlled Water Circulation obviates the risk of corrosion and thermal shock.

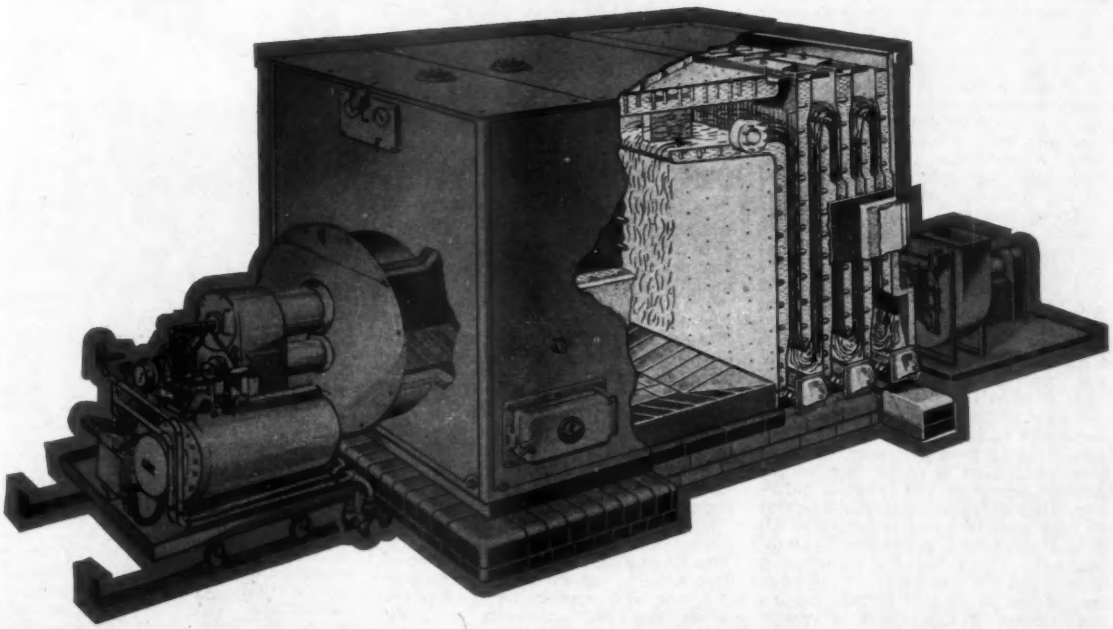


These advanced features of design, coupled with an average operating efficiency in the region of 85% result in a compact boiler unrivalled for economy, reliability and long life.

Available in 20 sizes ranging from 2½ million B.T.U./hr. at pressures up to 100 lb. sq. in. and built to A.O.T.C. requirements.

HIGH EFFICIENCY BOILERS

STEAM AND HOT WATER



CENTRAX **CENTRAX LIMITED, Newton Abbot, Devon. Tel: Newton Abbot 2251-5**
LONDON SALES OFFICE: 248-250 Tottenham Court Road, London, W.1. Telephone: LANgham 2364/5

This hoist tower, which will be exhibited, incorporates the principle of the Safway Unit Frame equipment which by means of its welded frame structure and the use of a triangular cross brace to connect the frames, is in itself a very simple form of construction that has an ease and speed of handling far greater than normal equipment. The design of the equipment has the added advantage of built-in safety. An example of the advantages claimed for this tower is that 50 ft. of it complete were erected by unskilled labour (three men) in two hours. This speed of handling makes it possible to move the hoist actually on the site. An extra saving in labour can be shown if the tower is moved without dismantling by means of a tower crane. Extra features include safety gates, safety mesh panels, and boarding-out equipment which is used to fill in any space around the hoist platform.

Stewarts & Lloyds Limited, *Upper Brook Street, London, W.1*

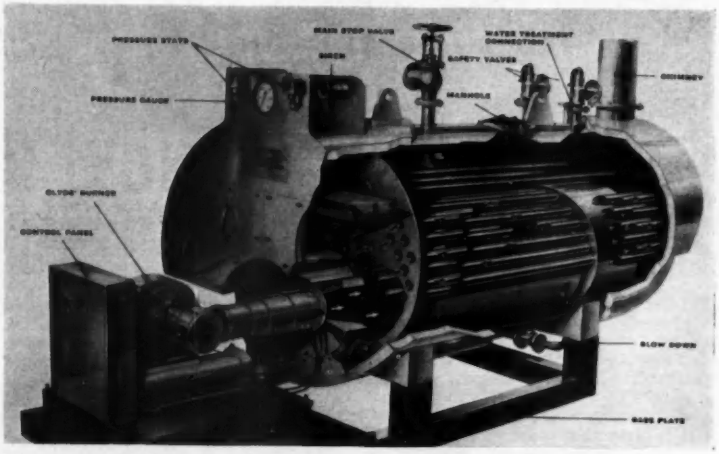
A resonance bending-fatigue machine used in Stewarts and Lloyds' department of research and technical development at Corby is one of the exhibits on the company's stand. The machine, which is used for investigations into the fatigue strength of tubes and welded joints, will be carrying out tests on a welded-on fin tube made by the Extended Surface Tube Company. Such tubes, in service in nuclear boilers, can be subject to vibrations set up by the gas flowing over them, and it is necessary to know the strength of the tubes under these conditions. Other items on the company's stand will include: a short length of 12 in. nominal bore seamless steel pipe, ends suitable for welding, with red lead internal protection and woven glass reinforced sheathing externally—typifying pipe supplied for high-pressure mains for gas grids; an 8 in. n.b. seamless steel pipe inside a 16 in. o.d. seamless steel pipe, as supplied for the disposal of atomic wastes. A section of thick-walled austenitic tube, suitable for operating at elevated temperatures; stainless-steel pipe coil; a bent extended-surface tube; non-ferrous pipe fabrications; buttwelded pipe joints; 6 in. standard Viking Johnson couplings with restraining harness; 18 in. extra heavy marine Viking Johnson couplings with supporting brackets; 6 in. Viking Johnson flange adaptor; 2 in. Junior coupling with plug in lieu of centre register; and 4 in. Victaulic joints. Exhibiting on the same stand will be the Extended Surface Tube Company, which was formed by Stewarts and Lloyds Limited, and Imperial Chemical Industries Limited, to meet the need for a specialist company which would use the growing knowledge on the performance of finned tube resulting from the many investigations undertaken in recent years in the nuclear, petroleum and chemical industries. They will exhibit examples of welded fin tube made by a new technique which is said to produce a remarkably clean, neat weld; high- and low-fin Integron in steel and stainless steel. These tubes are for use in nuclear reactor circuits and samples of tubes used in various gas-cooled reactors will be on display.

John Thompson Limited, *Wolverhampton*

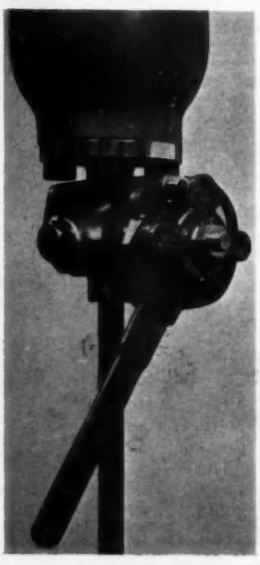
The various companies in the John Thompson Group will each feature exhibits representative of their extensive manufacturing range. John Thompson Water Tube Boilers Limited will show a marine type "La Mont" exhaust-gas, waste-heat recovery boiler which is one of the standard range of marine-type waste-heat boilers manufactured by the company. Models and photographs of power station installations where the boilers and associated equipment has been supplied by this company, will also be shown. John Thompson (Pipework) Limited, will show examples of headers and pipework in alloy and mild-steel manufactured by this John Thompson company to meet the ever-increasing temperature and pressure requirements of modern boiler plant. John Thompson Ordnance Company will exhibit one of the two gearboxes associated with the visual observation and fuel removal equipment supplied for the Berkeley Nuclear power station, illustrating the facilities offered by this company in the manufacture of special purpose machinery. John Thompson (Wilson Boilers) Limited will feature a model of the "Multipac" packaged boiler, illustrating the range of standard packaged units manufactured by this company. Shown for the first time will be the "Demipac" packaged boiler, suitable for oil or coal firing, and designed to cover the range of 500-2,000 lb./hr. John Thompson (Triumph Stoker) Limited will have on view a travelling-grate stoker for sectional boilers. This unit, known as the "Mini-stoker" will be actually working during the exhibition. This John Thompson company will also be exhibiting a vibratory ash-extractor, designed to deal with shell type boiler installations as an improved alternative to more conventional types of ash-extractors.

Ronald Trist & Co. Ltd., *Bath Road, Slough, Bucks.*

A selection of Mobrey magnetic level switches will be shown on displays so arranged that when floats are raised, an audible alarm is sounded. Of particular interest will be a new switch, type S102/F54, which has all parts in contact with the liquid, manufactured in ebonite. This switch is designed to meet those applications where, due to the nature of the liquid being handled, the normal Mobrey switch, in either aluminium, bronze or stainless-steel cannot be used. A demonstration unit, having two level switches mounted through the side of a Perspex tank containing water, will demonstrate the consistent accuracy in operation of Mobrey magnetic level switches. A new exhibit on show will be the Mobrey sequencing blow-down cock, for use with steam boiler water-level controls and alarms, this cock is ratchet-operated to ensure that the operator always follows the correct procedure



(Above). The Dennipac wet back packaged boiler. [John Thompson (Wilson Boilers) Limited.]



(Right). Mobrey sequencing blow-down cock. (Ronald Trist & Co. Ltd.)

for blowing down the float-chamber. A special feature will be a working demonstration of the latest Mobrey modulating level controller, this machine being designed primarily for fitting to steam-raising boilers for the purpose of maintaining the water-level closely in relation to the evaporation rate. A full range of the latest electrically operated boiler controls will be on view. Another display will show the well-known steam-operated Thermofeed feedwater regulator and the latest design of Hilo steam-operated whistle alarm. A working model will feature the latest Electricon smoke alarm and smoke density equipment. Smoke alarm type ASB.6500 gives warning when the smoke emitted from a chimney has exceeded a predetermined permissible maximum. It is simple and robust and is ideally suited to small boiler plants where excessive smoke emission must be avoided.

Vokes Genspring Limited, *Henley Park, Guildford, Surrey*

A wide range of pipe and ducting-support equipment, which is used extensively throughout industry, particularly in connection with power stations of the conventional and nuclear types, will be on show, as will "M"-type constant-support hangers for supporting pipes and ducting in power stations, refineries, chemical plants, etc., together with variable-support hangers for similar applications, but where less critical conditions apply. The company will also be exhibiting sway braces, which are ideal for the protection of large steam lines, feed water lines, exhaust, compressor and hydraulic lines from shock or vibration; and the Universal tool support for use with heavy manually-operated tools and equipment used in mass-production methods. Genflex bellows expansion joints, which range in size from 3 in. to 120 in. dia., and are used principally to absorb the expansion and contraction of pipe systems owing to temperature changes, will be on display. These bellows supersede the conventional method of absorbing pipe-movement by means of expansion loops. They are compact, flexible, and will absorb vibration and movement in all planes, thereby simplifying installation and reducing maintenance costs.

G. & J. Weir Limited, *Cathcart, Glasgow, S.4*

Four completely new Weir units will be shown, as well as a number of well-established products, and two subsidiary companies will also be showing their products. A feature of the Weir stand will be two large photographic enlargements portraying the world's largest boiler feed pump, and also a "packaged" Weir closed-feed system for ships—both actual size. Three of the new products are marine units, namely:—the Weir "F1" two-stage flash evaporator, the Weir "D1" marine evaporator, and the Weir high-vacuum exhaust steam-turbine. The fourth is the Weir "EF2" multi-stage electrofeeder, which is one of a new range of multi-stage electrically-driven centrifugal pumps for smaller land-boiler feed duties. They are capable of handling from 1,000 to 2,500 gal./hr. with maximum discharge pressures of 330 to 280 lb./sq. in. g. at these loads. Other well-established Weir products on display will include:—the successful Weir two-element "Robot" boiler feed-regulator which was introduced at the 1959 exhibition, together with an illuminated panel which demonstrates the function of the regulator under various boiler conditions; the Weir "WL" turbo-pump unit, the glandless high-speed marine boiler feed-pump which dispenses with oil lubrication; the Weir "R2" starting air-compressor, which is the latest version of the two-stage rotary reciprocating design introduced at Olympia in 1959. It has been designed for diesel engine starting duties aboard ship. The Weir "Multiflash" sea water distillation plant will be represented by a 1/24th scale model of a 1 million gal./day plant similar to the two units recently designed and built for the Government of Kuwait, Persian Gulf.

Worthington-Simpson Limited, *Lowfield Works, Newark, Notts.*

Worthington-Simpson will be showing a representative selection of "Monobloc," centrifugal, steam and power pumps, together with reciprocating and rotary air-compressors. A working model of an automatic priming system will also be on view. Exhibits which are being shown for the first time include a cargo oil-pump, a high-head centrifugal pump, an open-impeller "Monobloc" pump, a sump-pump, and a 1½-in. "Vortex" pump. The recently-developed 6L13 high-head centrifugal pump is capable of delivering 920 gal./min. of water against a total head of 440 ft. Maximum capacity of this model is 1,700 gal./min. against a total head of 340 ft. The 3DMO52 open-impeller "Monobloc" pump is one of a range of pumps, recently introduced, which are specially designed to handle slurries, liquids containing small solids, viscous liquids up to approximately 1,000 seconds Redwood No. 1, paper stock up to 2½ per cent. consistency, as well as clear liquids. Maximum capacity (water) is 360 gal./min. maximum head is 86 ft. A two-stage "Vortex" pump is also being shown, which is capable of operating against a total head of 750 ft. when run at 3,500 r.p.m. the capacity of this model being 30 gal./min. "Vortex" pumps are ideal for applications requiring small capacities with high heads and particularly for boiler feed duties. The vertical triplex power pump is one from a range covering pressures from 945 lb./sq. in. to 11,700 lb./sq. in. and capacities from 69 gal./min. down to 4.5 gal./min. Pumps in this series are specially suited for oil pipeline and refinery duties, hydraulic descaling processes and boiler feed duties. Representative of the Worthington-Simpson range of steam pumps will be the 10 in. × 7 in. × 10 in. horizontal duplex model which has a maximum capacity of 228 gal./min. Maximum steam and liquid pressures are 200 and 250 lb./sq. in. g. respectively, thus meeting a wide range of industrial requirements.

W. H. Allen Sons & Co. Ltd., Bedford, have received orders from the **Harland Engineering Co. Ltd.,** of Alloa, for six Allen-Stoeckicht epicyclic gear units for motor-driven boiler-feed pumps for installation in the Drakelow "C" and Bankside "B" Power Stations of the Central Electricity Generating Board. The gears will be built at the company's Atlas Works, Pershore, Worcestershire. For the Drakelow "C" station, four 5,650-h.p. speed-increasing gear units have been ordered, each designed to increase the motor speed of 1,460 r.p.m. to the pump speed of 4,500 r.p.m. The two gears for Bankside "B" Power Station will transmit 2,700 h.p. continuously each, and increase the motor speed of 1,490 r.p.m. to the pump speed of 5,500 r.p.m.

* * *

William Boby & Co. Ltd., Rickmansworth, Herts., have been awarded a £13,000 contract by I.C.I. Limited for the supply of a dealkalisation base-exchange plant at a new heavy organic chemicals factory at Severnside.

The appointment is announced of **Mr. Ronald G. Hooker,** J.P., as deputy managing director of K. & L. Steelfounders and Engineers Limited, Letchworth. The company is an important member of the George Cohen 600 Group, and operates one of the country's largest and best equipped steel foundries as well as manufacturing the Jones range of mobile cranes. In 1951, Mr. Hooker joined the Brush Group and in the following year was appointed general works manager of J. & H. McLaren Limited, Leeds. In 1954 he joined the board of Brush Electrical Engineering Co. Ltd., as works director, being promoted to general manager in 1957.

* * *

Among orders placed within the last few weeks by the Central Electricity Generating Board for power station and associated plant, is that to **Babcock & Wilcox Limited** for the supply of the ash and dust-handling plant for units Nos. 9-12 at Drakelow "C" power station, near Burton-on-Trent.

An order received recently by **A.E.I. Limited,** from the Central Electricity Generating Board, is part of a new scheme which will enable more power to be transmitted without adding to the number of overhead lines; the Board's policy being to preserve the countryside as far as possible by stepping up transmission voltages to 400-kV. The first such line is being built between Monk Fryston and High Marnham to provide operating experience for the new system. A.E.I. will supply high-voltage tap changers for voltage regulation on the transformers at each end of the line.

* * *

As one of the special activities of the Association during its fiftieth year of incorporation, the **B.E.A.M.A.** is arranging a two-day export conference which will be held on October 5th and 6th, 1961. The President of the Board of Trade, the **Rt. Hon. Reginald Maudling,** M.P., has promised to speak to the participants at an official luncheon on the first day. A full programme is now being arranged.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Freezing in feedwater heaters

When feedwater heaters, installed in the open air, are shut down during cold weather, it is possible for water remaining in the tubes to freeze, so causing damage. This raises the question of how well feedwater heaters drain when taken out of service. Tests made with full-scale heaters and single tubes, showed 40 per cent. of tube-capacity remaining after the tubes had been allowed to drain. Tilted installation raises problems of fabrication and level control. Probably the best answer is to evaporate the water by steam-heating from the shell side. Full-scale tests were made with two new heaters, one with 25-ft. and one with 35-ft. tubes. Heaters were levelled, filled with water, and all vents and drains opened. When the water stopped draining, the remaining water was measured. Tests were made to find the angle required to remove essentially all the water, and it was found that an angle of about one degree enabled the tubes to be completely drained. The shell side drains almost completely in the level position. Single-tube tests were made with $\frac{5}{8}$ in. tubes on a 20-ft. straight tube and a U-tube with 20-ft. legs. Tubes were cleaned with detergent and steam to rule out any oil effect, and tests run on a planer bed to assure levelness. The U-tube was supported with the bend in the vertical plane, and the result was the same as with the heaters—about 40 per cent. of capacity does not drain from a level tube. With long feedwater heaters, a one degree tilt involves raising of the back-end considerably—$7\frac{1}{4}$-in. for a 35-ft heater, or $5\frac{1}{4}$-in. for a length of 25-ft. Building a heater for this much tilt raises several problems. If the heater has a full-length sub-cooler, some tube rows must be omitted, to avoid flooding part of the condensing surface. This calls for a larger diameter and more-expensive heater. Nozzles extending up or down must also be specially installed to compensate for the tilt, in order to maintain the terminal face of the nozzle in the horizontal plane. A tilt of 0.2 deg. will clear all but about 10 per cent. of the water, and involves little problem with liquid-level control; the nozzle-tilt and misalignment can probably be accommodated in the piping. Without further testing, however, there is no way of knowing whether the 10 per cent. water remaining in the tubes will cause trouble. Blowing the water out with air was investigated. It was estimated that an air speed of at least 50-ft./sec. was needed. For an average-size heater, this would necessitate about 3,500 cu. ft./min. Tests were made on one full-size heater where only about 15 per cent. of the residual water could be blown out. Air-blowing is not technically a practical method for removing all the water in a heater. All tubeside water can be removed by evaporating it with steam in the shell, and heaters can remain in the level position. All vents and drains must first be opened, to remove as much water as possible, low-pressure steam is then admitted to the shell, residual water in the tubes evaporates, and leaves through the tubeside vent and drain connections. When the vapour ceases, the steam is shut-off and all the shellside vents and drains in the heater are opened. (*Power*, Vol. 105, No. 2, February 1961, p. 84.)

800-MW turbo generators in U.S.A.

On December 23rd, 1960, the Tennessee Valley Authority awarded to the General Electric Co. a contract for two 800-MW, 3,600/1,800 r.p.m. steam turbine-generators. These units are believed to be the largest ever ordered. The first unit is scheduled to be commissioned in September 1964 at a location not yet determined. Plans for the second unit are not firm; the contract permits its cancellation up to March 1st, 1962, with some modification in the first unit's price. The authority's first large cross-compound unit—a 500-MW unit—was purchased from General Electric Co. in the autumn of 1957. About a year later, TVA awarded its first foreign turbine-generator contract, also a 500-MW unit, to C. A. Parsons & Co. Ltd., England. In the latter part of 1959, TVA purchased a 500-MW unit, from the Brown Boveri Company, and a 600-MW unit, from General Electric Co. Later, the capacity of this unit was re-rated to 650-MW, and a second identical unit was purchased. In the summer of 1960, TVA decided that its system required further expansion to meet estimated load requirements for the winter of 1964-1965. Discussions were held with all domestic and foreign turbine-generator manufacturers. TVA then decided that the 800-MW size was suitable to most of the manufacturers, and would provide the most economical addition to its system. Therefore the invitation-to-bid, on which the contract was awarded, required an 800-MW unit, rated at 2,400 lb./sq. in. and 1,050/1,000 deg. F. (*Power Engineering*, Vol. 65, No. 2, February 1961, p. 46.)

Superheat reactor to be built in U.S.A.

The General Electric Company, in conjunction with seven New York State utilities, are planning to build an $8-million superheat developmental reactor to help extend the technology of nuclear superheat for eventual application to large-scale nuclear power plants. The new reactor will be designed, built, and owned by the G-E Atomic Power Equipment Department (APED) at its Vallecitos Atomic Laboratory. The seven New York State utilities have formed a non-profit making corporation known as the Empire State Atomic Development Associates Inc. (ESADA), which will participate in the superheat development programme by providing $5,750,000 towards design and construction of the reactor. Members of the ESADA group are Central Hudson Gas & Electric Corp. Consolidated Edison Co. of N.Y., Long Island Lighting Co., New York State Electric & Gas Corp., Niagara Mohawk Power Corp., Orange & Rockland Utilities, and Rochester Gas & Electric Corp. The ESADA group is participating in the programme as part of its over-all plan for ultimate development, design and construction of a large 300 to 500-MW

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nuclear-electric generating station. The new reactor, rated at 15,000 thermal kilowatts, will be built alongside the Vallecitos boiling-water reactor, where earlier basic test programmes demonstrated the feasibility of nuclear superheat. The superheat reactor will be used to raise the temperature of steam produced in this reactor to levels achieved in conventional modern power stations. (*Power Engineering*, Vol. 65, No. 2.)

500-MW set at Philip Sporn plant

The second of the world's largest steam turbo-alternator sets to date went into commercial operation on December 31st, 1960, at the Philip Sporn plant of the American Electric Power System. The 500-MW unit of the Ohio Power Company is an exactly similar set to the Michigan Electric Company's breed plant unit which went into service on July 31st last on the Wabash River in Indiana. It appears that the associated unit boiler will operate at 3,500 lb./sq. in. and 1,050 deg. F. with two stages of reheat, both to 1,050 deg. F. This steam will go to a 3,600 r.p.m. cross-compound turbine-generator, consisting of two cylinders, and exhausting into its own condenser. The Sporn unit is expected to have a heat rate of about 8,500 B.Th.U./kWhr, which would make it the best ever for a unit operating on a commercial basis. Incidentally, the Sporn generator stators are water-cooled whereas the breed design is oil-cooled. Conventional hydrogen-cooling is employed for the rotor. The boiler design at Sporn has undoubtedly profited from the earlier experiences at Breed where it has been admitted that major difficulties were encountered at times of starting-up. These difficulties, it is reported, have been satisfactorily corrected at Breed, and the unit has either met or exceeded expectations. The transition from the conventional 2,400 lb./sq. in. single reheat drum-type design of the manufacturer furnishing the unit, to the 3,500 lb./sq. in. double reheat selection which Breed made, revealed the necessity for (1) a forced-circulation as against a natural-circulation flow, as well as (2) a redistribution in the apportioning of heat distribution surfaces. The designers further found that the furnace and burner dimensions had a pronounced effect on the heat absorption at both the furnace-level and the convection section of the steam generator. Recirculating gas, they found, was an excellent aid in correcting for imbalances. A reported important feature of the Breed furnace design is membrane type of wall construction. The walls are constructed of shop-welded panels made up of 1-in. to 1⅛-in. o.d. tubes spaced on 1½-in. centres, with the space between the tubes closed by a $\frac{1}{16}$ in. thick bar, machine-welded to both sides of the adjacent tubes. The convection heat absorption section comprises three parallel gas-passes. The secondary superheater and the economiser extend across the entire depth of the convection section. The first and second-stage reheaters are located in separate gas-passes, and all but a small part of the primary superheater is located in the third gas-pass. At full load, the gas temperature entering the first section of secondary superheater which is on 18-in. side spacing, is approximately 2,200 deg. F. A by-pass system has been designed for the boiler flow at start-up. (*Combustion*, Vol. 32, No. 8, February, 1961.)

Ultrasonic boiler-scaling equipment has been specified by the U.S.S.R. Government for the Scotch Marine boilers in 15 Russian tankers, being built at Turku. **H.N. Electrical Supplies Limited,** Rochelle Works, Brixton Hill, Place, S.W.2, who specialise in the manufacture of Crustex descaling equipment, have received an order to fulfil these requirements.

* * *

Mr. A. V. Roberts, F.B.I. Scholar, Grad.I.E.E., etc., has just returned to South Africa to pioneer an Instrumentation Department for **Evershed & Vignoles Limited,** through their agents, British Agencies (Pty.) Limited. Mr. Roberts attended the Post Graduate Control Course at Cambridge University under Mr. J. F. Coles, and subsequently gained considerable experience with Evershed & Vignoles Limited, whilst on a two-year F.B.I. Scholarship in Britain.

* * *

Mr. Alan Threlfall, A.M.I.Mech.E., Grad.I.E.E., has been appointed sales manager of Perkins Gas Turbines Ltd., Peterborough, and will be responsible for co-ordinating Perkins gas turbine sales throughout the world.

* * *

Richard Thomas and Baldwins Limited has announced the following appointments to the engineering staff at the Spencer Works, now under construction at Llanwern, near Newport, Mon.: **Mr. F. J. Feltoe,** A.M.I.Mech.E., A.M.I.E.E., chief fuel and power engineer; **Mr. J. W. Oswald,** A.M.I.E.E., chief electrical engineer, and **Mr. S. Shillito,** A.M.I.Min.E., manager, productivity engineering department.

A new publication has recently been issued by **Babcock & Wilcox Limited.** It is publication No. 1721 and is entitled "Babcock Corner-Tube Steam Boilers." Illustrations of typical corner-tube boiler installations, both stoker-fired and oil-fired, are given. This type of boiler is said to be extremely flexible in design and arrangement, and able to meet a wide variety of industrial applications, producing from a few hundred up to approximately 100,000 lb./hr. of steam. The publication lists the features and advantages of the boiler, among which are that it is compact and space-saving, and is suitable for a variety of fuels—solid, liquid, gaseous or waste-product, singly or in combination. The corner-tube boiler is also available as a hot-water boiler.

* * *

Mr. Ivon A. Bailey has been elected a vice-president and **Mr. John O. Hitchcock** an assistant vice-president of The International Nickel Company of Canada Limited. Mr. Bailey remains chairman and chief officer of the International Nickel Co. (Mond) Ltd., and of Henry Wiggin and Co. Ltd. Mr. Hitchcock remains managing director of The International Nickel Co. (Mond) Ltd. and deputy chairman of Henry Wiggin and Co. Ltd. He will also continue as second chief officer of both companies.

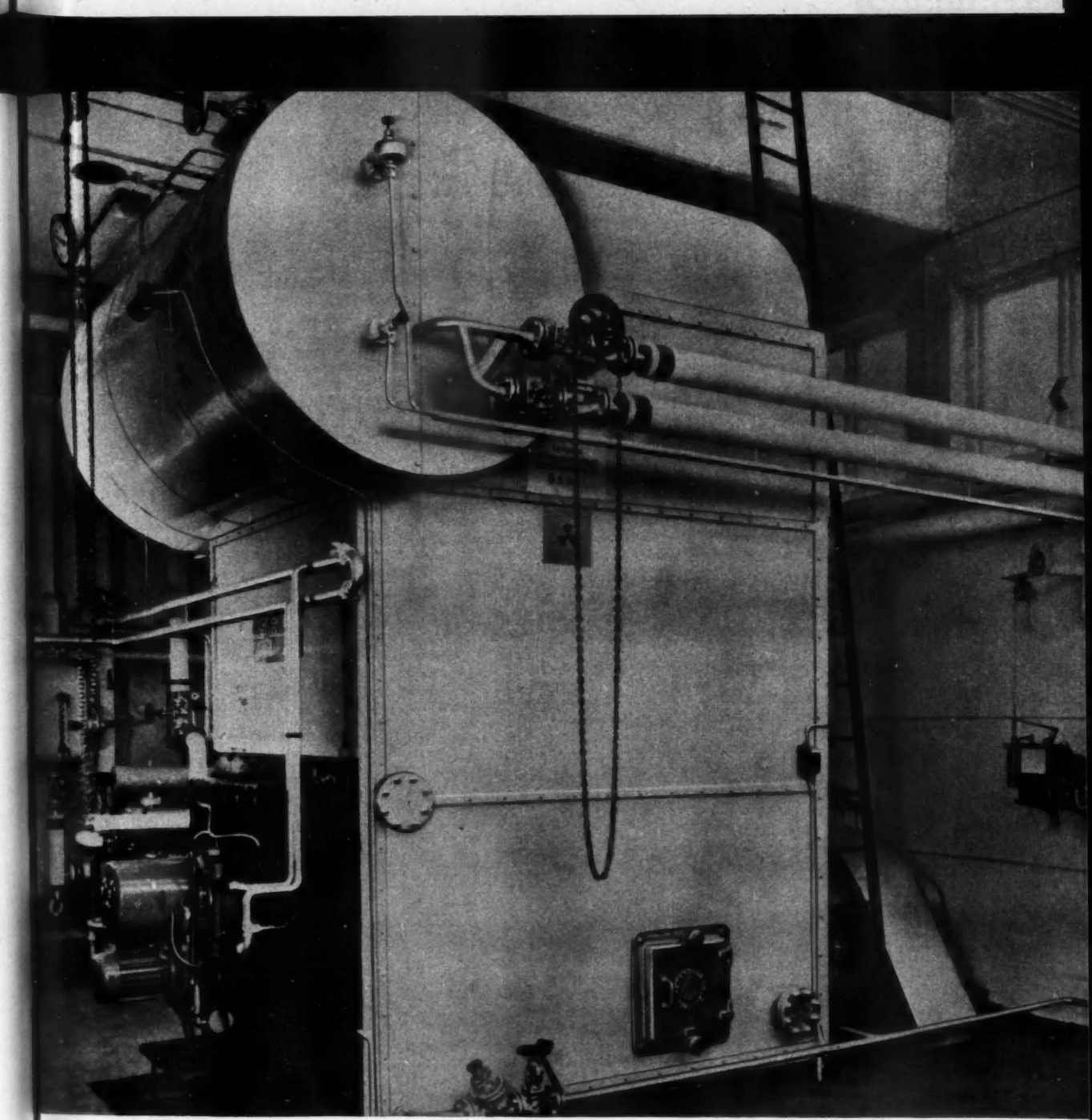
* * *

G. & J. Weir Holdings Limited, Cathcart, Glasgow, S.4, announce the appointment of **Mr. J. W. Atwell,** M.Sc., as an additional director. Mr. Atwell is managing director of the principal operating subsidiary company of the group, G. & J. Weir Limited.

The Trent Valve Co. Ltd., 47, Great Eastern Street, London, E.C.2, recently issued a new catalogue entitled "Trent Valves." This well produced publication of some 130 pages, deals with the extensive range of valves, cocks, pressure gauges, level gauges, pipeline strainers, etc., which the company manufacture. In this publication the company have endeavoured to be as comprehensive as possible within the limitations of the space available. Special detailed information has only been included for those items thought necessary and where it is considered that such information is of direct use to the user. However, sufficient information has been given by illustration and text matter, to enable the users to identify their own requirements, and it is pointed out that full detailed information will be given on request, where such information has not been included. Much useful information is included at the back of the publication, such information consisting of reference details, conversion details, flange, flange drilling details, etc.

* * *

Mr. Richard Adams, M.I.Mech.E., M.I.Chem.E., etc., has been appointed general manager of a newly-created Engineering Division of Castrol Limited. The Castrol Engineering Division, which is located at the Group's London headquarters, Castrol House, has been formed to bring together and intensify the expanding engineering operations of the Group. These consist of the design, manufacture, installation and servicing of a very wide range of lubricating plant and equipment for both automotive and industrial applications.



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FULL DETAILS OBTAINABLE FROM Newton Chambers & Co. Ltd., Engineering Division, Thorncliffe, Sheffield.

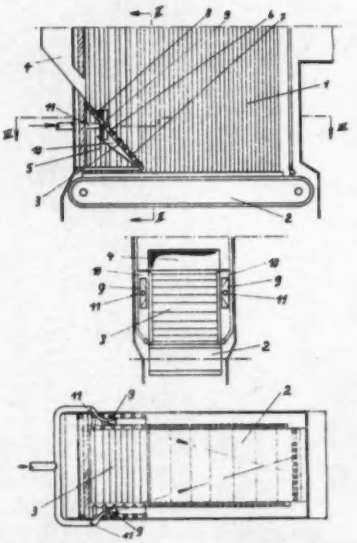
Newton Chambers

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Boiler furnace

This invention relates to a boiler furnace having an inclined grate delivering solid fuel to a moving main combustion grate. Referring to Figs. 4, 5 and 6, below the combustion chamber (1) of a steam boiler is mounted a moving grate (2) and above the stoking end of this grate an inclined grate (3) is mounted. The inclined grate (3) extends from the stoking chute (4) downwards to the combustion grate and divides a chamber (5) from the combustion chamber. The inclined grate is formed in a standard arrangement of water tubes (7) arranged like the rungs of a



Figs. 1, 2 & 3. British Patent No. 858,399.

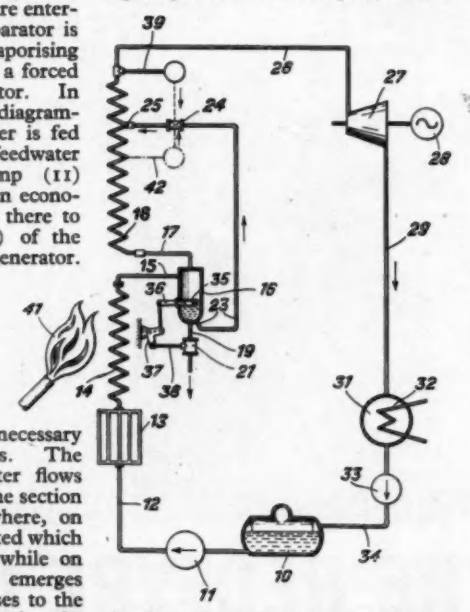
ladder, and provided with ribs which connect the sides (8) of the ladder-like structure with one another. The tubular system of the inclined grate (3) is connected to the water-circulating system of a steam boiler. At both sides of the chamber (5) jet blowers (9) are mounted in pockets (10), the secondary-air feeding these blowers being supplied through tubes (11). The jet blowers (9) draw combustion gases by suction from the combustion chamber (1) through the inclined grate (3) and into the chamber (5) after which they are expelled through the nozzle-shaped openings of the blowers. The expelled gases are mixed with the secondary-air and are given a blast direction which forms an angle with the central longitudinal axis of the combustion chamber (1), so that a good turbulence will be ensured in the combustion chamber (1). *British Patent No. 858,399 issued to Schmidt'sche Heissdampf Gesellschaft m.b.H. Complete specification published January 11th, 1961.*

Separator for forced-flow steam generator

This invention relates to a method of discharging liquid working medium which is separated in a separator from the liquid-vapour mixture entering the separator, which separator is disposed between the vaporising and superheating sections of a forced through-flow steam generator. In the steam generator shown diagrammatically in Fig. 4, feedwater is fed from the starting vessel or feedwater tank (10) by a feed-pump (11) through a feed line (12) to an economiser (13) and passes from there to the vaporising section (14) of the tube system of the steam generator.

Fig. 4 (right). British Patent No. 858,928.

In continuous operation, water is vaporised in the vaporising section (14) except for a reserve necessary for the regulation process. The mixture of steam and water flows from the outlet line (15) of the section (14) to a separator (16) where, on the one hand, water is separated which collects in the lower part, while on the other hand, steam emerges through a line (17) and passes to the superheater section (18). At the bottom of the separator (16), an outflow line (19) for separated liquid medium is provided, which line is equipped with a regulating valve (21). Another outflow is also provided from the separator (16) and its line (23) equipped with a regulating-valve (24) leads to an injection point (25) in the superheater section (18). A live-steam line (26) is connected at the outlet end of the superheater section (18), and connects the steam generator to a turbine plant (27) which drives an electric generator (28). The turbine plant (27) is, for the sake of simplicity, illustrated with only one stage. It can equally well be of multistage construction, or be made as a preliminary consumer, or in some other manner. The exhaust steam from the turbine plant (27) is fed through a line (29) to a condenser (31) equipped with a cooling system (32). The condensate is fed by a condensate pump (33) to the starting vessel (10) by way of line (34). Means for weighing the liquid content or for determining the liquid-level in the separator (16) are known. A magnitude corresponding to the instantaneous quantity of liquid present in the separator (16)



is determined in this way, and in dependence on this magnitude, a signal is transmitted for the purpose of adjusting the valve (21). By way of example, a float (35) for determining the liquid-level is shown. This float, by means of a lever (36) is sealed off on its passage through the wall of the separator; a bell crank lever (37) and a link (38) adjusts the regulating valve (21) so as to open or close it in dependence on the level or liquid content of the vessel.

The liquid to be injected into the superheater section (18) at the injection point (25) is controlled by operation of the regulating valve (24) in dependence on a superheater temperature measured by means of a thermostat (39). The manner of operation is as follows. If, for example, the intensity of the fire (41) is suddenly increased as a result of a change of load, then in the first instance more water is vaporised in the vaporising section (14) and the quantity of water separated out in the separator (16) is reduced. The liquid-level and hence the float (35) drop. The lever (36) tilts in the clockwise direction, the bellcrank lever (37) rocks in the opposite direction, and the link (38) moves to the right and partially closes the valve (21). The outflow through the line (19) decreases, while the outflow through the line (23) remains unaffected thereby, as long as the superheater temperature sensed by the thermostat (39) does not vary. Instead of sensing the superheater temperature at the outlet of the superheater (18) by means of thermostat (39), it is possible to sense at another point, for example, in the centre of the superheater by means of a thermostat (42) or directly at the injection point, which thermostat then effects a corresponding adjustment of the regulating valve (24). The valve (24) may also be influenced from both measuring stations. The adjustment may have a proportional or a proportional integral characteristic. *British Patent No.* 858,928 *issued to Sulzer Frères Société Anonyme. Complete specification published January 18th,* 1961.

Automatic regulation of boiler pressure

The object of this invention is to provide a means for controlling a physical variable such as the pressure of a steam boiler. In order to ensure an optimum economic boiler operation, it is necessary to maintain a prescribed ratio, corresponding to the particular boiler and operating conditions, between the amount of combustion air supplied to it with the fuel. In boilers with pulverised-coal firing, the meeting of this requirement involves considerable practical difficulties particularly in view of the fact that it is impossible to measure out the calories supplied to the furnace in the fuel sufficiently accurately and reliably during operation. The pulverised-fuel is fed to the burners by means of rotating or other feeders, the working speed of which generally serves as a measure of the B.Th.U.s supplied. Nevertheless, this measurement is very inaccurate and unreliable, because the volume and the weight of the fuel supplied at a constant rate by the feeder vary constantly, and very considerably, depending on the momentary dispersability of the fine coal which is determined by its moisture-content and grain size, its air content, etc. In practice, differences up to the order of about 30 per cent. have been observed. If, in addition, fluctuations in the calorific value occur, as frequently happens when low-grade fuels are used, the differences in the calorific value supplied may be even greater. In these circumstances, an optimum economic course of the combustion process cannot be expected if it is controlled solely on the basis of the working speed of the fuel feeder as a measure of the supply of B.Th.U.s without regard to this fluctuation. In Fig. 5, numeral (1) denotes the steam drum of the boiler which is in communication with the manifold (3) through the superheater (2). Numeral (4) represents the axially movable control rod of an automatic combustion regulator, the settings of which correspond to the particular calorific requirements. The supply of combustion air and fuel to the furnace is likewise controlled in known manner by this control rod (4). Connected to the control rod (4) through a cam drive (5 and 6) is a set of co-axial rollers (7) which can travel along a fixed rail (8). Resting on the rollers (7) is a balance beam (9) the left-hand end of which is loaded with two tension springs (10 and 11). The tension of the spring (10) can be manually set to the desired value, while the tension of the spring (11) depends on the particular setting of the piston rod (19) of a hydraulic servo-motor (17). The right-hand side of the balance beam (9) is connected by means of the rod (12) to the left-hand end of a lever (13) which is loaded by two diaphragms (14 and 15) working in opposition, to one another. The diaphragm (14) is connected to the boiler drum (1), the diaphragm (15) to the manifold (3). The right-hand end of the balance beam (9) carries the slide of an oil control (16) governing the servo-motor (17). Connected in series with it and with the servo-motor (17) is a piston flowmeter (18) which indicates the direction and speed of the oil-flow by the deflection of its piston from the centre position. By means of the spring (23) the piston of the flowmeter (22) influences a lever (21) which pivots between two fixed stops (24) and on which the piston rod (19) of the servo-motor (17) also acts by means of the spring (20). The slide of a control means (25) which governs the servomotor (26) is suspended from the lever (21) by means of the rod (33). The piston rod (27) of this servo-motor (26) comprises a thread on which a nut constructed in the form of a friction wheel (30) is mounted for adjustment screwing. This is in engagement with a constantly-driven friction disc (31) and is connected by means of a barrel ring (36) and a spring (32) acting on its arm (37), to the right-hand end of the lever (21). The piston rod (27) acts by means of the spring (28) on the lever (29) of the fuel regulator (not shown), and wherein the working speed of the fuel feeder is influenced by the particular tension of the spring acting on the lever (29). The tension-rod (33) of the control means (25) carries two stops (35) which extend into the path of movement of the arm (37) of the barrel ring (36) which is prevented from rotating by means of a guide means (not shown). *British Patent No.* 859,687 *issued to Energeticky Ustav. Complete specification published January 25th,* 1961.

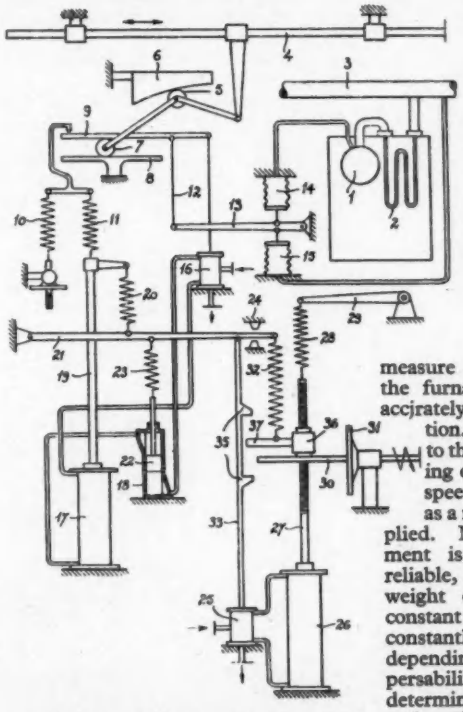


Fig. 5. British Patent No. 859,687.

Nuclear steam plant with gas-cooled reactor

In view of the high structural cost per kW of a nuclear power plant, every effort must be made to convert the greatest possible part of the heat supplied by the reactor in the relatively low temperature range into useful mechanical or electrical work. Therefore, a steam plant with gas-cooled reactor, a high-pressure back-pressure steam turbine, a lower pressure steam condensing steam turbine, and a heat-exchanger in which steam is generated by means of the heated cooling gas of the reactor, is characterised according to the invention in that the feedwater derived from the condenser of the condensing turbine is divided into two streams. One of these streams is brought to a higher pressure than the other; the high-pressure feedwater is evaporated and superheated in the heat-exchanger and then supplied to the high-pressure back-pressure steam turbine. The lower-pressure feedwater is evaporated in the heat-exchanger, then mixed with the exhaust steam of the back-pressure steam turbine. Both lower-pressure steam streams are superheated in the heat-exchanger and then supplied to the lower-pressure condensing steam turbine. The lower-pressure turbine is preferably a condensing-extraction turbine, so that the feedwater can be preheated by steam extracted from this turbine. In the plant shown diagrammatically in Fig. 6, the steam turbine is divided into a high-pressure back-pressure turbine (5) and into a lower-pressure condensing-extraction turbine (6). The feedwater derived from the condenser (8) is brought to an intermediate pressure by the pump (9) and is then forced to flow through the feedwater heat-exchangers (7) heated by steam extracted from the turbine (6) and then through the lower-pressure evaporator heating surfaces (2a). At a point ahead of this heating surface, part of the feedwater is branched off and supplied at a higher pressure, imparted to it by the feedwater pump (4), into the high-pressure evaporator heating surface (3a). The steam generated in (3a) passes through the superheater (3b) and from this to the high-pressure back-pressure turbine (5). The exhaust steam from this turbine is mixed at the point (12) with the lower-pressure steam generated in the evaporator heating surface (2a) and both lower-pressure streams then pass through the superheater (2b), and the thus superheated steam is supplied to the lower-pressure condensing turbine (6). *British Patent No. 861,891 issued to Licentia Patent-Verwaltungs-G.m.b.H. Complete specification published March 1st, 1961.*

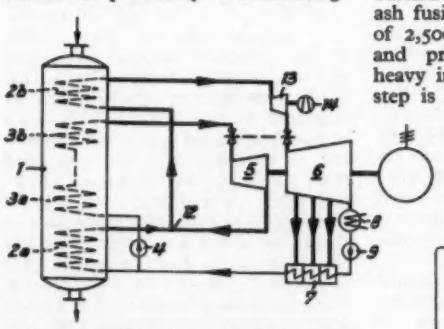
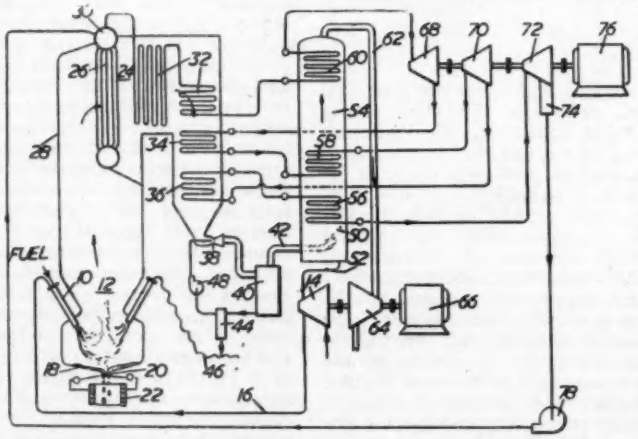


Fig. 6 (left). *British Patent No. 861,891.*

Fig. 7 (below). *British Patent No. 861,924.*

Binary fluid powerplant

This invention relates to the production of power by a binary fluid power plant. In the power cycle diagram (Fig. 7), a slag-forming fuel is passed by a burner (10) into a furnace chamber (12). Simultaneously, a free-oxygen-containing gas, such as air at super-atmospheric pressure, is passed into the furnace (12) by the burner (10) in a fuel-to-oxygen ratio insufficient for complete combustion, the air being supplied from a compressor (14) through line (16). The fuel and oxygen-containing gas react in the furnace, and the fuel is partially burned at a temperature, above its ash fusion temperature, of the order of 2,500 deg. F. to 3,000 deg. F., and produces a combustible gas, heavy in carbon monoxide. Such a step is normally called fuel gasification. The arrangement of the furnace (12) and the position of the burner (10) cause the molten slag from the combustion process to separate from the gas and accumulate on the floor (18) of the furnace. The slag is withdrawn through a tap hole (20) into a lower slag-tank (22), where it is collected for removal. The combustible gaseous products contain gas-carried solids, such as unburned carbon and solidified or semi-molten slag, sulphur oxides and vaporised ash products, such as alkalies and rare metal oxides. The gas flows upwardly through the furnace chamber (12), which is provided with radiant steam-generating wall-tubes (28), into a gas-pass (24), wherein it is cooled to a temperature such that substantially all of the vaporised ash products condense. This cooling is accomplished by heat transfer surface in the form of a tube-bank (26) wherein steam is generated and delivered to an upper drum (30) which also receives the steam generated by the tubes (28). The steam flows from the drum (30) into a primary or low temperature superheater (32) where it is heated. The gas, while flowing in the gas-pass (24), passes over a low temperature section (36) of a second steam reheater before passing out of the gas-pass. At the exit from the gas-pass the gas is accelerated in a venturi nozzle (38) at which time a washing liquid, such as water, is sprayed into the gas completely to wash the gas and entrain the ash and unburned solid products contained therein. The gas and water mixture then passes into a gas-water separator (40) from which clean gas passes through a line (42), and the water and ash products pass into a liquid-solid separator (44). In this separator (44), the ash products are removed, the ash products passing to a conveying means (46) and the liquid passing to the suction of a recirculating pump (48) for the recycling of the washing process liquid. The conveying means



(46) returns the ash and unburned solid particles to the furnace (12) where the carbon particles have an opportunity to burn, and the ash is caught in the molten ash of the furnace and removed therewith. The clean combustible gas in line (42) passes into a second reaction zone or furnace (50). There it is mixed with a free-oxygen-containing gas or air at super-atmospheric pressure supplied through a line (52) from the compressor (14). This air or free-oxygen-containing gas is supplied in a fuel-oxygen ratio sufficient to cause complete combustion in the reaction zone (50) and produces a clean, high-temperature combustion gas under pressure. A second gas-cooling pass (54) opens from the furnace (50) for the flow of the clean gas from the furnace. The clean gas is progressively cooled to a predetermined delivery temperature by a high vapour temperature portion (56) of the second reheater, a high vapour temperature portion (58) of the first reheater, and a high temperature or secondary portion (60) of the superheater. The gas leaving the pass (54) is delivered through an outlet line (62) to a power-extracting expansion device or gas-turbine (64) from which the gas is exhausted from the cycle. The gas-turbine (64) is arranged to drive the compressor (14), and any excess power is absorbed by an electric generator (66). The predominant amount of power developed in the cycle is produced from the reheat steam cycle wherein a high-pressure turbine (68) is driven by the superheated steam coming from the secondary superheater (60). The exhaust from the high-pressure turbine passes into the low-temperature portion (34) of the first reheater, and thence into the high-temperature portion (58) where it is heated to its final pre-determined temperature. Thence it passes into an intermediate-pressure turbine (70) where power is extracted by expansion. The exhaust steam from the intermediate-pressure turbine passes to the low-temperature portion (36) of the secondary reheater, and thence into the high-temperature portion (56) of the secondary reheater from which it is discharged into the inlet of a low-pressure turbine (72). In this turbine, the steam is expanded while work is being extracted, and the exhausted steam passes into the condenser (74). The turbines are shown, by way of example, as connected to a single-shaft which drives an electrical generator (76). The exhaust steam is condensed in the condenser (74) and a pump (78) returns the condensate to the steam generator. It will be seen that the highest metal temperature associated with the steam cycle is achieved under conditions where a clean-gas atmosphere prevails, thus permitting a most compact and effectively utilised heat transfer apparatus. *British Patent No.* 861,924 *issued to Babcock & Wilcox Limited. Complete specification published March 1st,* 1961.

Refresher Course for Works and Plant Engineers

A residential refresher course entitled "Combustion Engineering," will be held at Prestatyn Holiday Camp from Monday, May 29th to Saturday, June 3rd, 1961. The aim of the course is to provide engineers concerned with the burning of substantial tonnages of solid, liquid and gaseous fuels on boilers and furnaces with an integrated series of lectures which will not only examine and review existing good practice, but will also introduce and consider the latest developments in the field of combustion. Starting with a study of available fuels, the syllabus will include the principles of combustion for all types of boiler and furnace plant with the various auxiliaries and ancillary items of equipment, instrumentation and automatic control. The lecturers will be experts, and will make liberal use of films, slides and other visual aids. Detailed and comprehensive lecture notes will be supplied to each student. The inclusive fee for the course will be 12 guineas. The director of studies will be **W. Short, Esq.,** B.Sc., M.Inst.F. Brochures and application forms can be obtained from:—**C. K. R. Davies, Esq.,** Secretary to the Course, **National Industrial Fuel Efficiency Service,** Baltic House, Mount Stuart Square, Cardiff.

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Drysdale and Co. Ltd., Yoker, Glasgow, states that **Mr. T. L. Mackie,** sales director, retired from the board of directors on December 31st, 1960, for health reasons. His services will be available to the company in a consultative capacity.

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Mr. John Porter has been appointed purchasing manager at the Ebbw Vale Works of Richard Thomas and Baldwins Limited, in succession to the late **Mr. R. B. Fisher.**

The National Industrial Fuel Efficiency Service announce a new series of courses, which will focus attention on the latest developments in the firing and handling of solid fuel in industrial plants and commercial premises. The courses will be held in Manchester. Each course will include sessions covering a short revision of combustion principles, the maintenance of boilers, mechanical stokers and firing equipment, and the choice of suitable fuels. In addition, there will be a comprehensive introduction to the latest combustion equipment and automatic controls that are now available to industrial and commercial solid fuel users. Visits to several industrial plants where new equipment has been installed recently and is in operation, will be made during the course. The first course, starting on Monday, April 10th, 1961, will finish on Friday, April 14th, 1961. The fee for the course (excluding hotel accommodation) is 12 guineas. Enrolment forms and a course syllabus may be obtained from N.I.F.E.S., 71, Grosvenor Street, London, W.1.

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Elliott Brothers (London) Limited, a member of the Eliott-Automation Group, recently announced the formation of a new subsidiary company, **Rotron Controls Limited,** owned jointly with The Rotron Controls Corporation of Woodstock, New York. Elliotts have a two-thirds controlling interest in the new company. Rotron Controls Limited will have its headquarters at the Elliott-Automation factory at Airport Works, Rochester, Kent. It will manufacture the range of flowmeters and associated equipment developed by the Rotron Controls Corporation for positive and mass-flow measurements in the oil, gas, water and petro-chemical industries, and will sell these instruments throughout Europe, the Middle East and the British Commonwealth (except Canada).

Foster Wheeler Limited have placed an order with **W. H. Allen Sons & Co. Ltd.,** Bedford, for a 36/34-in. horizontal-spindle, double-suction cooling-water pump for the Esso Petroleum Co. Ltd., Fawley Refinery. The pump will be constructed in bronze, to pass 33,000 U.S. gal./min. against a total head of 212 ft. It will be motor-driven. Four other Allen cooling-water pumps (one 36/34 in. and three 30/24 in.) are already in service at this refinery.

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Richardsons, Westgarth & Co. Ltd., pioneers of the vacuum flash evaporator in Great Britain, have received an order from the Air Ministry for four 12,000 gal./day sea-water evaporators, together with associated equipment. These evaporators will provide drinking water for Royal Air Force personnel at Sharjah in the Trucial Oman, and Masirah Island off the coast of Muscat and Oman. Richardsons Westgarth evaporators in the Middle East (installed, in course of erection, or under consgruction) will provide a total daily output of 2,500,000 gallons of fresh water—sufficient to supply the needs of a town of 100,000 inhabitants.

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The Metal Industries Group announces that **Mr. J. M. Paul,** M.I.E.E., has been appointed managing director of Foster Transformers Limited and Lancashire Dynamo Nevelin Limited. **Mr. Humphrey Bott,** M.I.Mech.E., M.I.Mar.E., has been appointed chief engineer of Fawcett Preston and Co. Ltd.

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An £18,000 contract has been awarded to **William Boby and Company,** water-treatment engineers, Rickmansworth, Herts., by **Monsanto Chemicals Limited.** It is for the supply of a de-aeration plant to their Ruabon, North Wales, factory.

NOTES *Personal* AND *Industrial*

The British Electrical and Allied Manufacturers' Association announces that **Mr. A. L. G. Lindley,** chairman and managing director of The General Electric Co. Ltd., has succeeded **Sir Leslie Gamage** as his company's representative, following Sir Leslie's retirement.

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Mr. Ronald Lambart Basset has been appointed a director of Associated Electrical Industries Limited. On his appointment, he has resigned from the board of A.E.I.'s Woolwich Group. Mr. Basset joined the board of Siemens Bros. & Co. Ltd. in 1952, and also became a director of Siemens Electric Lamp Supplies Limited, Siemens Edison Swan Limited, and Alfred Graham & Co. Ltd.

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The National Coal Board announce that **Mr. D. M. Clement** has been appointed director-general of finance. He succeeds **Mr. A. W. John,** who has become finance member of the Board.

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It is announced by A.E.I. (Rugby) Limited, that **Mr. E. T. Muston** has been appointed general superintendent, Rugby Works. Since 1949, he has been superintendent of the Fabrication Factory. Mr. Muston was appointed superintendent of the company's Peterborough Works in July, 1945, but returned to Rugby in June, 1949, on being appointed superintendent of Fabrication Factory.

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Mr. D. Edmundson, general manager of the Rugby Works of A.E.I. Limited, since January, 1960, has been appointed manufacturing manager, A.E.I. Electronic Apparatus Division, to fill the position previously occupied by the late **Mr. E. T. W. Barnes. Mr. G. P. Thompson,** until recently manager, manufacturing, at Rugby, is now manager, Rugby Works.

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Mr. James Oldroyd, T.D., M.A., F.C.I.S., who has been secretary of The British Electrical and Allied Manufacturers' Association since 1952, has been appointed general manager of The Lead Development Association, as from the beginning of April next.

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Mr. G. B. Longbottom, B.Sc. (Hons.), A.M.I.Mech.E., A.F.R.Ae.S., has been appointed technical manager of The Hymatic Engineering Co. Ltd., of Redditch, Worcs., in succession to the late **Mr. H. R. Haerle.**

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Mr. K. A. Robinson, A.M.Brit.I.R.E., has been appointed to the board of Lancashire Dynamo Electronic Products—a company in the Metal Industries Group. Mr. Robinson joined Lancashire Dynamo Electronic Products as chief development engineer in 1948, and a year later was appointed chief engineer. Lately, he has assumed responsibility for marketing.

Major F. D. Outridge, R.A. (Retd.), F.C.C.S., has been appointed assistant to **Capt. R. A. Villiers,** C.B.E., director of the Scientific Instrument Manufacturers' Association, 20, Queen Anne Street, London, W.1.

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Mr. R. P. Newman, A.M.I.Mech.E., has been appointed head of the members' service department of the British Welding Research Association in succession to **Mr. P. H. R. Lane,** who has been appointed director of research of the Drop Forging Research Association. Mr. T. R. Gurney, A.M.I.C.E., will succeed Mr. Newman in charge of fatigue researches at the British Welding Research Association.

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The British Iron and Steel Research Association has announced that **Mr. H. F. Spencer,** managing director of Richard Thomas and Baldwins Limited, has been appointed president in succession to the late **Sir Charles Bruce-Gardner.**

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Mr. W. Kenneth G. Allen, chairman of W. H. Allen Sons & Co. Ltd., Bedford, and Gwynnes Pumps Limited, Lincoln, is making a two-month business tour of Australia. On the outward journey he had business discussions in India and Pakistan, and on the return journey from Australia, he will make further business visits in Canada, arriving back in Great Britain early in May.

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The Mond Nickel Co. Ltd., an affiliate of The International Nickel Company of Canada Ltd., changed its name as from February 28th, 1961, to The International Nickel Company (Mond) Limited. In announcing the proposed change of name, the chairman, **Mr. Ivon A. Bailey,** said that it did not involve any change in the company's organisation or in its business activities. The board, in consultation with **The International Nickel Company of Canada Ltd.,** the parent company, took the view that the change of name would, in addition to indicating the international nature of the company's activities, serve to identify it more closely with the Canadian company and the United States affiliate, The International Nickel Company Inc.

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Mr. E. F. Coppock has been appointed group financial controller to Metal Industries Limited. He succeeds **Mr. P. Jardine,** who is taking up full time directorships with J. G. Statter & Co. Ltd., and Minerva Mouldings Limited, which are two M.I. subsidiaries.

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International Boilers and Radiators announce that **Mr. H. A. S. Moule,** formerly sales director of Glow Worm Boilers Limited, and executive director of Sunrod Domestic Boilers Limited, has joined the International board.

Mr. John Arthur Croft, at present deputy-chairman and managing director of Crofts Engineers (Holdings) Ltd., Thornbury, Bradford, has been appointed chairman of that company and its principal operating subsidiary companies, including Crofts (Engineers) Limited, and Carter Gears Limited. Mr. Croft was appointed deputy-chairman and managing director of Crofts Engineers (Holdings) Limited, on January 1st, 1954, and now succeeds his father, the late Sir Arthur Croft.

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William Boby & Co. Ltd., water treatment engineers, has appointed **Edgar Arrigo Limited** as its agent in Malta. The managing director, **Mr. Michael Boby,** announced the agreement when he returned from a visit to Malta on March 3rd.

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Recently, a large party of the Yorkshire Branch of the Institution of Mechanical Engineers visited the Britannia Works of **Hopkinsons Limited,** Huddersfield. In the course of their tour round the works, the party saw in course of manufacture, valves and boiler mountings for power stations and many other types of installations all over the world, including large butterfly valves for Trawsfynydd, Hinkley Point and Latina nuclear power Stations.

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W. H. Allen Sons & Co. Ltd. announce that the address of their London Office is now—25, Victoria Street, Westminster, London, S.W.1, the telephone number—Abbey 2712, remains unaltered.

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A highlight of the **BEAMA** Golden Jubilee this year will be a dinner to be held on Tuesday, October 31st, 1961, at the Grosvenor House, Park Lane, London. The Prime Minister has been invited as the Guest of Honour, and has indicated that he will be pleased to attend if he possibly can.

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Four new directors have been appointed to the Board of Fletcher Miller Limited, a member of the Castrol Group of Companies. They are **Mr. J. R. Bickerton,** chief chemist at Fletcher Miller's Hyde (Cheshire) plant, **Mr. J. Birchenough,** works manager at Hyde, **Mr. R. A. Miller,** North London divisional sales manager, and **Mr. S. V. Tilley,** senior technical representative for the Midlands and South Wales.

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Ashmore, Benson, Pease & Co. Ltd. announce that agreement has been reached in principle for the sale of their foundry business as a going concern, to a new company, **Parkfield Foundries (Tees-side) Limited.** Ashmore, Benson, Pease are informed that the principals of the new company intend to continue to employ the majority of the existing foundry staff and workpeople.